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TSP Source Inventory Around Monitoring Sites in Selected Urban Areas, Philadelphia

PEDCo-Environmental, Inc.
Kansas City, MO

Prepared for

Environmental Protection Agency
Research Triangle Park, NC

May 79

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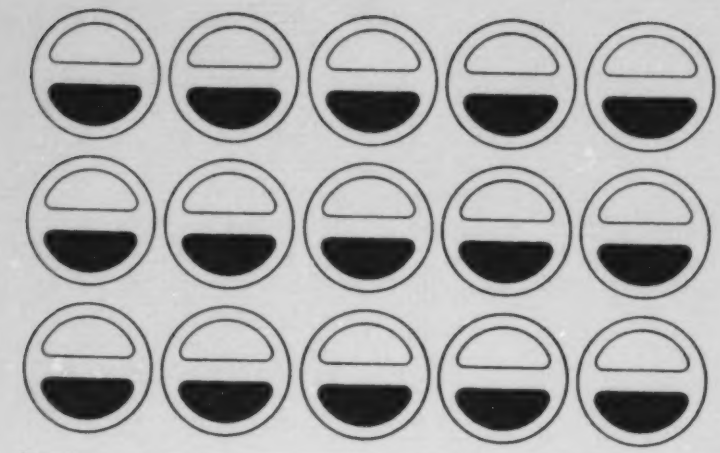

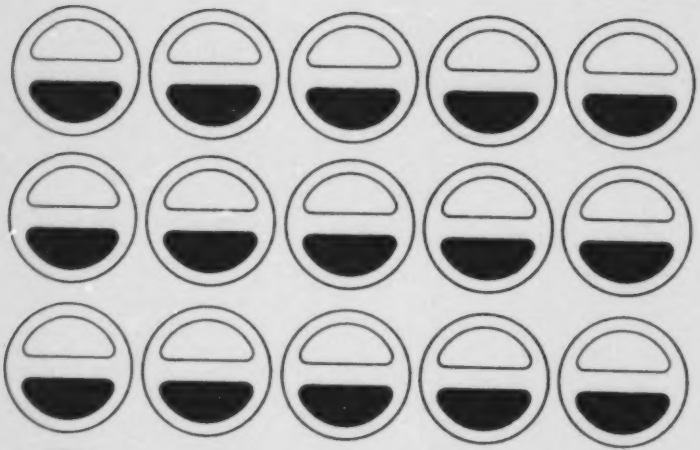

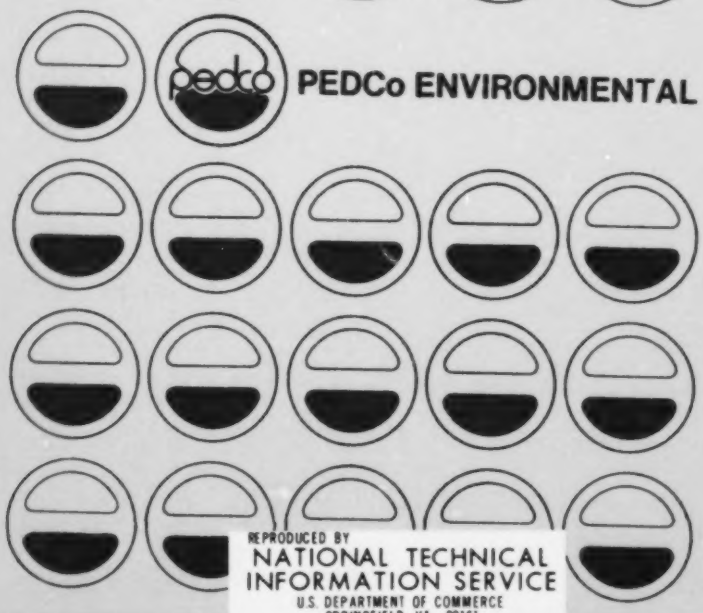

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EPA is developing an empirical model to relate ambient air quality to particulate emissions and land use in the surrounding area. This receptor-oriented model will be used for evaluating the effect of particulate control measures on concentrations at individual sites in a sampling network or for predicting air quality at a location where there is no sampler.

Several studies have indicated that there is a statistically significant relationship between particulate concentrations measured at a high volume sampler and the emission density within a limited radius surrounding that site. It is EPA's intention to improve the correlation observed for this basic source/receptor relationship by accounting for some or all of the following factors in the empirical model: Distance to sources, direction of sources, differential impact of point and area source emissions, sampler and source heights, surrounding land use. By using weighting factors for different emissions in the area around the sampler, the model will build on the basic relationship and attempt to increase its accuracy.

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TSP SOURCE INVENTORY AROUND MONITORING SITES IN SELECTED URBAN AREAS, PHILADELPHIA

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Contract No. 68-02-2603
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1. INTRODUCTION

EPA is developing an empirical model to relate ambient air quality to particulate emissions and land use in the surrounding area. This receptor-oriented model will be used for evaluating the effect of particulate control measures on concentrations at individual sites in a sampling network or for predicting air quality at a location where there is no sampler.

Several studies have indicated that there is a statistically significant relationship between particulate concentrations measured at a high volume sampler and the emission density within a limited radius surrounding that site.[1,2,3,4,5] It is EPA's intention to improve the correlation observed for this basic source/receptor relationship by accounting for some or all of the following factors in the empirical model:

- distance to sources
- direction of sources
- differential impact of point and area source emissions
- sampler and source heights
- surrounding land use

By using weighting factors for different emissions in the area around the sampler, the model will build on the basic relationship and attempt to increase its accuracy.

The model will utilize data obtained from a technique referred to as a microinventory. The original microinventory

procedure, as outlined in a 1974 report,[1] consisted of an inventory of particulate sources within a 1.5 mile radius of a high volume sampler and the calculation of an average emission density (in ton/mi^2/yr) for the entire area. Subsequent reports have reduced the area to a one mile radius but left the other procedures essentially the same.[2,3] Most of the improvements in the technique in these reports have occurred as a result of fugitive dust emission factor development.

The next refinement of the inventory technique was based on an observed relationship between particulate concentrations and average daily traffic (ADT) on nearby streets.[5] Available traffic and TSP data for two cities indicated that ambient concentrations were directly related to ADT on the nearest street and inversely related to the slant distance (hypoteneuse of height and horizontal distance) from the sampler to that street. This relationship has been incorporated into the microinventory by giving special consideration to streets and other localized sources (within 200 ft of the sampler) during the field survey.

The concept of decreasing impact with distance has been expanded in recent particulate analyses to include classification of point and area sources into different ranges of distance from the sampler.[6,7] The sources were also classified by general direction from the sampler. Emissions from all area sources within 1/4 mile of the monitor were tabulated. Separate tabulations were made for sources within a 1/4 to 1/2 mile radius and a 1/2 to 1 mile radius, with each of these two radii being divided into quadrants. Thus, a total of nine sectors within the 1 mile radius were considered separately in the area source emission inventory.

In these same partiuclate analyses, point source emissions within a five mile radius were tabulated with respect to distance and direction from the monitor. The larger

radius was specified for point source emissions because of their greater dispersion potential than lower level emissions from area sources. It is relatively simple to calculate or scale from a map the distance from each point source to the monitor. Likewise, the compass direction from the monitor to the source can be easily determined.

An additional refinement of microinventory procedures has recently been proposed, but not yet fully evaluated. Land use in the area surrounding the sampler is thought to be related to the concentration measured at the sampler. A recent study reported the predominant land use in each of the nine sectors in the area source inventory area.[7] A land use determination was also made for the area from 1 to 3 miles from the sampler and the 1/4 mile radius sector was further divided into four quadrants for land use classification.

All of the refinements described above have been incorporated in the microinventories for developing the empirical model. This will permit variables such as distance, direction, point vs. area source, height and land use to be included in the resulting model if they are shown to improve its predictive capabilities. It has been estimated that this detailed emission data and land use information is needed for approximately 100 sites in order to adequately consider all these variables.

PEDCo Environmental is collecting most of this detailed data base and providing it to EPA in the form of a series of reports, one for each of the five cities in which sites are to be surveyed:

Kansas City	- 32 sites
Portland	- 10 sites
St Louis	- 11 sites
Birmingham	- 14 sites
Philadelphia	- 10 sites

Another contractor, GCA Corporation, is providing information for 12 sites in the Boston area. In addition, Rockwell International is providing corresponding data for 12 sites in their RAMS sampling network in St. Louis. Altogether, this will provide EPA with data from 101 sites.

Each of PEDCo's reports follow the same format as this one. The reports are confined almost entirely to data presentation; data analysis and model development will be performed by EPA. All of the data in this report are presented in a format appropriate for EPA's use in their analysis.

The present report summarizes information for sites in the Philadelphia area. The 10 high volume sampling sites inventoried in the Philadelphia area have a wide distribution of exposures ranging from industrial to background. The locations of the sites are shown in Figure 1-1. The data collected for the sites are presented in Chapter 3. The methodology for performing the microinventories in Philadelphia is presented in Chapter 2.

Figure 1-1. Locations of high volume samplers in the Philadelphia area.

LEGEND

Site no.	Site location
1.	Fireboat Station, Allegheny Avenue and Delaware River
2.	International Airport, Island Road
3.	Roxborough Water Pump Station
4.	Northeast Airport, Grant Avenue and Ashton Road
5.	North Broad Street and Germantown
6.	Franklin Institute, 20th and Parkway
7.	1501 East Lycoming Avenue
8.	Broad and Spruce Streets
9.	Sewage Plant, Front and Pacha Streets
10.	500 South Broad Street

2. METHODOLOGY

MICROINVENTORY PROCEDURES

The microinventory technique described herein was developed over the past four years as part of particulate analyses in several regional areas. The procedures followed are not necessarily technically superior to alternative methods that might be used. However, they have evolved as a result of this past experience and are recommended for succeeding inventories, primarily to maintain consistency in data collection and to minimize the time required in the field.

The survey procedure employed in Philadelphia was to ground survey, via automobile, the sampler stations and all probable sources of emissions within a one mile radius of each sampling site. This method enabled the survey team to make the best observation of overall site exposure and to identify the sources with primary impact on the samplers. The one mile radius around each sampler was specified because that is approximately the range to which theoretical treatments (dispersion modeling) show that low level sources will have a significant impact.

Sources of fugitive dust and conventional point and area sources were located on maps during the ground survey and labeled with pertinent data, such as size and boundaries, observed activity and operational characteristics, and estimated emission rates. Two observers independently estimated and agreed upon parameters observed at each site to increase accuracy and completeness.

Presurvey and Preparatory Work

Prior to undertaking the field surveys, a presurvey was performed. This presurvey consisted of a two day visit to Philadelphia to gather the materials needed to perform the microinventories and to tour the sites to be inventoried. Point source, area source, and air quality data were obtained from the local air pollution control agency. Traffic volume maps were obtained from the local planning agency.

Two other types of maps were also utilized during the Philadelphia microinventories. USGS 7-1/2 minute quadrangle maps were used to locate sampler sites and point sources by UTM coordinates. They were also a convenient size and scale (1" = 2000') for covering the impact area--one mile radius for area sources and a five mile radius for point sources. A city street map was used for planning the survey route and in navigating the route.

During the presurvey, each sampling site to be inventoried was visited. Photographs were taken of the sampler location. Monitor height and placement were recorded on an auxiliary data sheet and the sampler was located on the city street map. If any physical interference was observed that could bias the air quality readings, that information was also noted. The site code, street address, and distances of the nearest intersecting streets or localized sources were determined and recorded.

Following this presurvey, the preparatory work needed to perform the field surveys was completed. A one mile radius was drawn on the USGS map for each site, and the major streets were identified thereon. Copies of each of these maps were made for field use. A separate sketch of the 1/4 mile radius area was drawn to scale (1" = 400') to provide even greater detail for the area close to the sampler. An alternative to the 1/4 mile radius sketch would have been to mark information directly on the aerial photo for each site.

Field Work

The actual inventory procedure followed was to begin at the sampler site and survey the 1/4 mile radius area first. The field team then observed each street within the 1/4 mile radius and noted the location of all the pertinent sources on the sketch. Closer inspections of the sources were made as necessary. All important parameters were independently estimated and then agreed upon by the two observers. For area sources, the type, dimensions, and activity rate were recorded. For point sources, the company name, source types, and estimated stack heights were noted. This information was usually recorded on an auxiliary data sheet.

The general condition of paved streets within the area was described on the 1/4 mile sketch by indicating whether streets were curbed or uncurbed. Surface conditions and dirt loadings were described as clean or dirty. Finally, the predominant land uses for the four quadrants were marked. The land use descriptors used are described in detail in a following section.

The above steps were repeated with little modification for the rest of the one mile radius survey area. In many cases, it was possible to inventory this area by driving across alternate streets, in a cross hatch pattern, covering each quadrant completely. In this way, all intersections and sources were observed from a maximum one block distance. Locations of point and area sources were shown on copies of the USGS map or, where available, on aerial photo maps; descriptions of the sources were recorded on the data sheets. Land use was determined both from the ground survey and from information obtained later from land use data.

Topography - The topography of each survey area was briefly characterized. Since the purpose was to account for any increase in concentrations that might occur as a result of

pollutant trapping or decrease due to an elevated sampler, the topography description was primarily concerned with sampler placement rather than the surrounding land area. In order to keep this element of the model as simple as possible, only four descriptors were used:

- Elevated receptor
- Valley receptor
- Street canyon receptor
- No special terrain

Measuring Distances of Sources - For purposes of determining the distance from a source to the sampler, the following rules were observed:

Within 200 ft of the monitor	- determine distance to ±5 percent during initial visit to the site
From 200 ft to 1/4 mile	- scale off the aerial photo map
From 1/4 to 1 mile	- scale off either the aerial photo map or the USGS map

Distances to sources within 200 ft of the monitor were recorded during the presurvey. Distances beyond 200 ft were scaled from a map and recorded on the data sheet at a later date following completion of the field work.

Defining Sources - So that all inventories were done with the same degree of detail, it was necessary to establish exactly what sources were to be included. Generally, all fireplace and furnace stacks from residential, commercial, or institutional buildings were accounted for under the fuel combustion area source category and were not inventoried.

If a stack emission appeared to involve an industrial process not included in the point source listing, the source was noted if the facility appeared to be operating at the time of the survey.

Defining what constitutes a fugitive dust source was somewhat more difficult; however, sources of fugitive dust would include at least the following activities:

- excavating
- grading
- detonation of explosives
- earth moving
- construction
- demolition
- site preparation
- sand blasting
- mining
- quarrying
- processing of sand, gravel, and rock
- crushing
- screening
- drying
- handling and transporting of materials
- barren storage areas or storage piles
- vehicle movement (reentrainment)
- unpaved roads
- unpaved parking lots
- agricultural tilling
- wind erosion of exposed surfaces
- feed lots
- campgrounds
- fairgrounds
- playgrounds
- athletic fields

Unpaved driveways or unpaved road shoulders were not included unless they were common to all the blocks in a particular segment. However, the presence of these sources often resulted in increased street dirt loadings, and those streets were noted to be dirty.

A significant factor in determining which temporary sources to consider is the time period for which the source is expected to be active. For example, a construction site should be included as a fugitive dust source only if the air quality data are for the period of time the site is active.

A checklist for the procedures discussed above is presented in Table 2-1. This list should facilitate both the planning and the execution of the field surveys so that consistent data collection is achieved for succeeding microinventories.

Table 2-1. CHECKLIST OF STEPS IN MICROINVENTORY

Presurvey and preparatory work

1. Identify sampling sites to be inventoried: record SAROAD code and street address
2. Determine distances to localized sources within 200 feet and sampler height (obtained during site tour)
3. Note possible interferences or biases (obtained during site tour)
4. Take photographs of site and surrounding area (obtained during site tour)
5. Obtain U.S. Geological Survey maps of the area (from either USGS or a local engineering supply store)
6. Obtain land use maps (from local Council of Governments)
7. Obtain traffic data (from local COG, or city or state transportation agency)
8. Obtain recent air quality data (local air pollution control agency)
9. Obtain gridded inventory of area source emissions (local agency)
10. Obtain point source inventory including annual particulate emissions and UTM coordinates (local agency)
11. Obtain aerial photographs (from local COG or city engineering department)
12. Prepare maps for field survey (USGS maps and 1/4 mile sketches)

Field work

1. Describe topography around sampler
2. Survey 1/4 mile area: locate all sources on 1/4 mile sketch, describe on data sheet
3. Note condition of streets
4. Survey remainder of one mile radius area: locate sources on copy of USGS map, describe on same data sheet as above
5. Determine predominant land use by sector

Calculations

1. Allocate area source emissions (from agency inventory) to one mile radius area and to subareas
2. Calculate emissions for discrete fugitive dust sources; assign to appropriate sectors
3. Calculate vehicle-related emissions by sector
4. Prepare table of point source data by increasing distance from site
5. Compare listing with point sources identified in field; add to list any sources missed
6. Add small point sources (less than 25 ton/yr) as an area source category
7. Make final decision on land use description for each sector

LAND USE DETERMINATION

Area sources were identified within one mile of each sampling site, but an attempt was made to determine the major land uses within a three mile radius of the site. The rationale for this extension was that the relative impact of land use has not yet been established, so it is reasonable to collect slightly more data than may ultimately be necessary for analysis. The 16 segments within the three mile radius are shown in Figure 2-1. The predominant land use in each segment was categorized based on descriptors listed in Table 2-2. Again, since the input requirements for land use data in the empirical model are uncertain, these descriptors may be modified at a later date.

An initial land use description was obtained for each segment from a land use map. This description was further refined from observations made during the ground survey and from USGS maps. In a few cases, the most appropriate land use designation may be the use which affects air quality most rather than the majority land use. This designation may change as the land area located in the sectors increases. For example, one or more point sources located in sector 1a would be sufficient to classify this sector as general industry. However, in sector 13 more than nine point sources (>25 tons) and a large percentage of industrial land area (>30 percent) would be required for a general industry designation. A similar rational was utilized to choose the most appropriate land use for sectors in which land use was not clearly defined. In summary, the land use descriptor chosen for each sector was based on available land use and point source data, USGS maps, and field surveys.

COLLECTION OF POINT SOURCE DATA

During the ground survey, an attempt was made to locate every significant particulate point source. Annual particulate emissions from those industrial sources identified

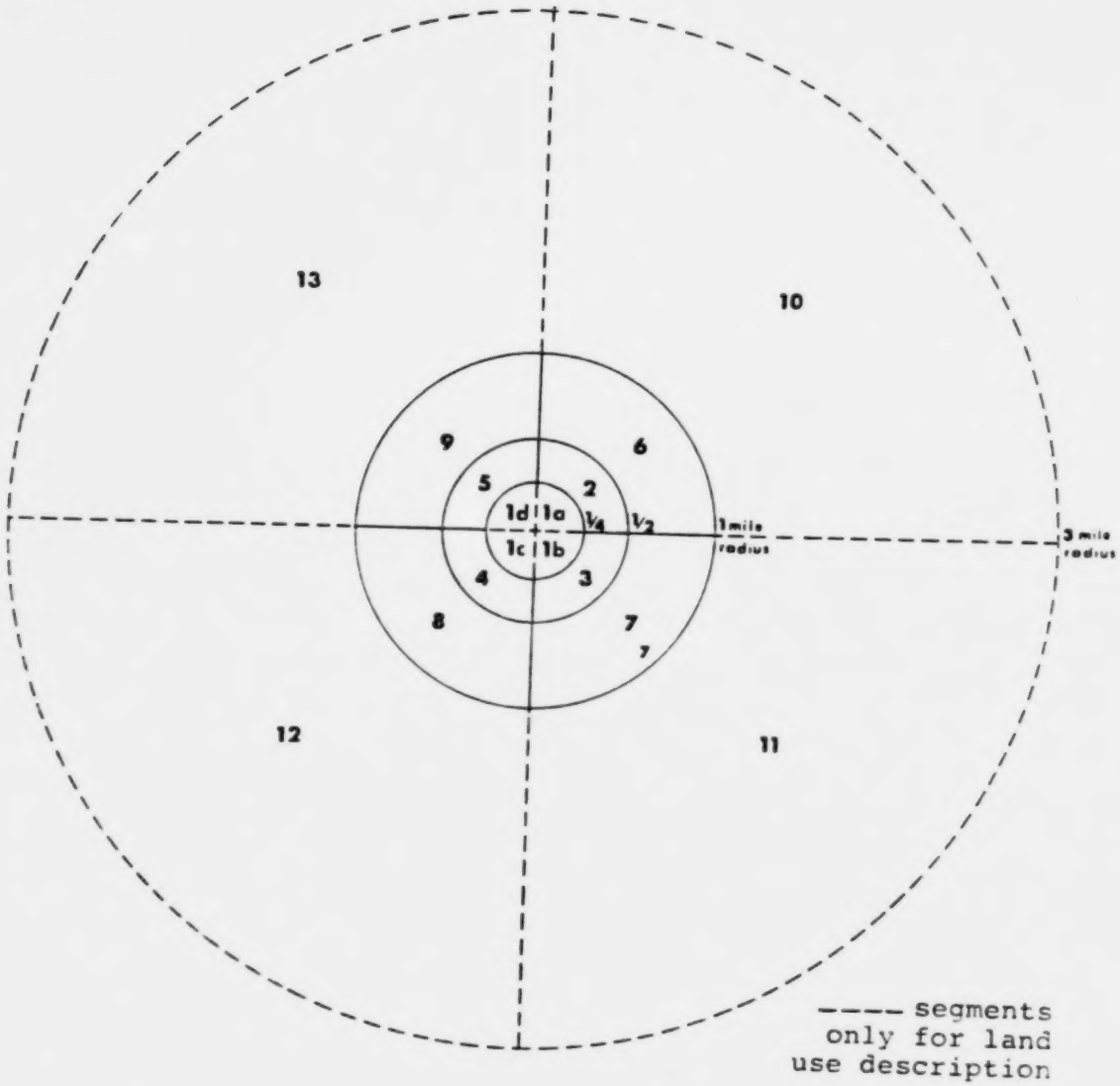


Figure 2-1. Land use and area source sectors used for the survey areas.

Table 2-2. LAND USE DESCRIPTORS

Descriptor	Characteristics
Undeveloped	No significant activity; includes parks, pasture land, lakes, rivers and forests
Agriculture	Land under cultivation at some time during the year
Light residential	Four or less dwelling units/acre
Dense residential	Greater than four dwelling units/acre, includes apartments
Suburban commercial	Retail businesses in strip development or shopping centers
Central commercial	Central business district
Light industry	Metal fabrication, warehousing, trucking, etc., includes few point sources
General industry	Controlled industrial processes includes majority of point sources
Heavy industry	Steel mills, foundries, coking, etc.
Airport	Municipal airport

were either obtained from a point source listing[8,9] or an engineering knowledge of the processes involved. Further, any source listed in the point source file and not identified in the survey was located using UTM coordinates and street addresses.

A table of point sources within five miles of the monitor was compiled for each of the sampler sites. Only those sources with estimated annual particulate emissions of 25 ton/yr or more were considered to be point sources. Smaller sources listed in the point source file were considered only if they were located within one mile of a sampler. The emissions from these sources were combined with either the industrial process or the industrial fuel combustion area source categories. The complete list of greater than 25 ton/yr point sources in the Philadelphia area is included in Appendix A.

CALCULATION OF AREA SOURCE EMISSIONS

As discussed previously, an area within a one mile radius was inventoried for each of the 10 sites. This area was divided into nine sectors as shown in Figure 2-1. Based on data obtained from the survey, estimates were made of fugitive dust emissions in each sector. All identified fugitive dust sources within the survey area were recorded on the data sheet with estimates of size, location, and activity. Appropriate emission factors were then applied to each source to calculate estimated annual emissions. These emission factors are discussed in Appendix B. The individual emission factors used for each source category in Philadelphia are listed in Table 2-3.

Conventional area source emissions not accounted for in the survey were included in order to determine total area source particulate emissions by sector. The categories of

Table 2-3. EMISSION FACTORS FOR MICROINVENTORIES

Source category	Emission factor	Units
Railroad yards	0.04	ton/acre/yr
Reentrained dust		
clean paved streets	3.0	gm/VMT
commercial streets	13.2	gm/VMT
exhaust	0.6	gm/VMT
Unpaved roads	2.6	lb/VMT
Cleared or exposed areas	0.02	ton/acre/yr
Construction	0.21	ton/acre/mo
Aggregate storage	1.4	ton/acre/yr
Unpaved parking lots	1.3	lb/VMT
Unpaved storage areas	0.1	ton/acre/yr
Grain elevators	1.8	ton/silo/yr
Incinerators	7.0	lb/ton of refuse

conventional area sources considered included emissions from fuel combustion, incinerators, locomotives, and vessels. Emissions from these sources were obtained from the gridded inventory of area source emissions for Philadelphia.[10] The emissions were summarized for the Philadelphia area by source category in 2.5 kilometer grids. The microinventory areas were superimposed on a map of the gridded inventory area; emissions were then apportioned to the microinventory areas from the grids on the basis of land area. These area source emissions were reapportioned to the nine sectors of the one mile radius area on the basis of land area: sector 1, 6.0 percent; sectors 2-5, 4.7 percent each; sectors 6-9, 18.8 percent each. It was not practical with the available data to determine exact emissions by sector. Although this appears to negate the effect of sectoring in Philadelphia, the conventional area source emissions are generally much less than those from fugitive dust or vehicle-related sources.

Emissions for two other sources, vehicle exhaust and reentrained dust from streets, were calculated for each sector based on the vehicle miles traveled (VMT) in each sector. These VMT data were calculated from traffic volume maps.[11] Annual traffic volumes were obtained by multiplying the daily VMT by 365.

3. SITE SUMMARIES

A six page summary was compiled for each of the 10 particulate sampler sites inventoried in the Philadelphia area. These site data summaries are presented in this chapter.

The first page of the summary is a complete description of the individual site including the SAROAD code, the street address, the location and height of the monitor, the land use within a three mile radius, the topography in the vicinity of the site, localized sources within 200 ft of the monitor, and air quality data for a four year period.

The sampler site locations and surrounding one mile radius survey areas are illustrated on the second page. The third page of each summary is a more detailed map showing sources within 1/4 mile of the sampler.

Two photographs illustrating the sampler, one viewed in the direction where the greatest potential for localized pollution influence existed, are presented on the fourth page of each summary.

A listing of all the point sources identified in the Philadelphia area is included in this report (Appendix A). The listing is limited to those sources emitting greater than 25 ton/yr. Each source is designated by number. The fifth page of the summaries lists any of these point sources located within a five mile radius of the sampler. Those sources within one mile are also located on the map of the survey area.

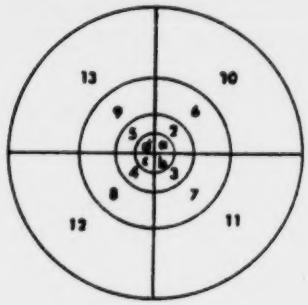
Any source emitting less than 25 ton/yr and within one mile of the sampler is included under the industrial process area source category or allocated to the appropriate area source combustion category.

The sixth page summarizes the area sources for a one mile radius about each sampler site.

DESCRIPTION OF SITE

SAROAD code - 39 7140 019

Location - Fireboat Station,
Allegheny Avenue and Delaware River



Monitor height - 15 ft, on AMS trailer

Land use, by sector -

1a	general industry	6	general industry
1b	general industry	7	light industry
1c	general industry	8	light industry
1d	general industry	9	dense residential
2	general industry	10	general industry
3	undeveloped	11	dense residential
4	light industry	12	dense residential
5	dense residential	13	dense residential

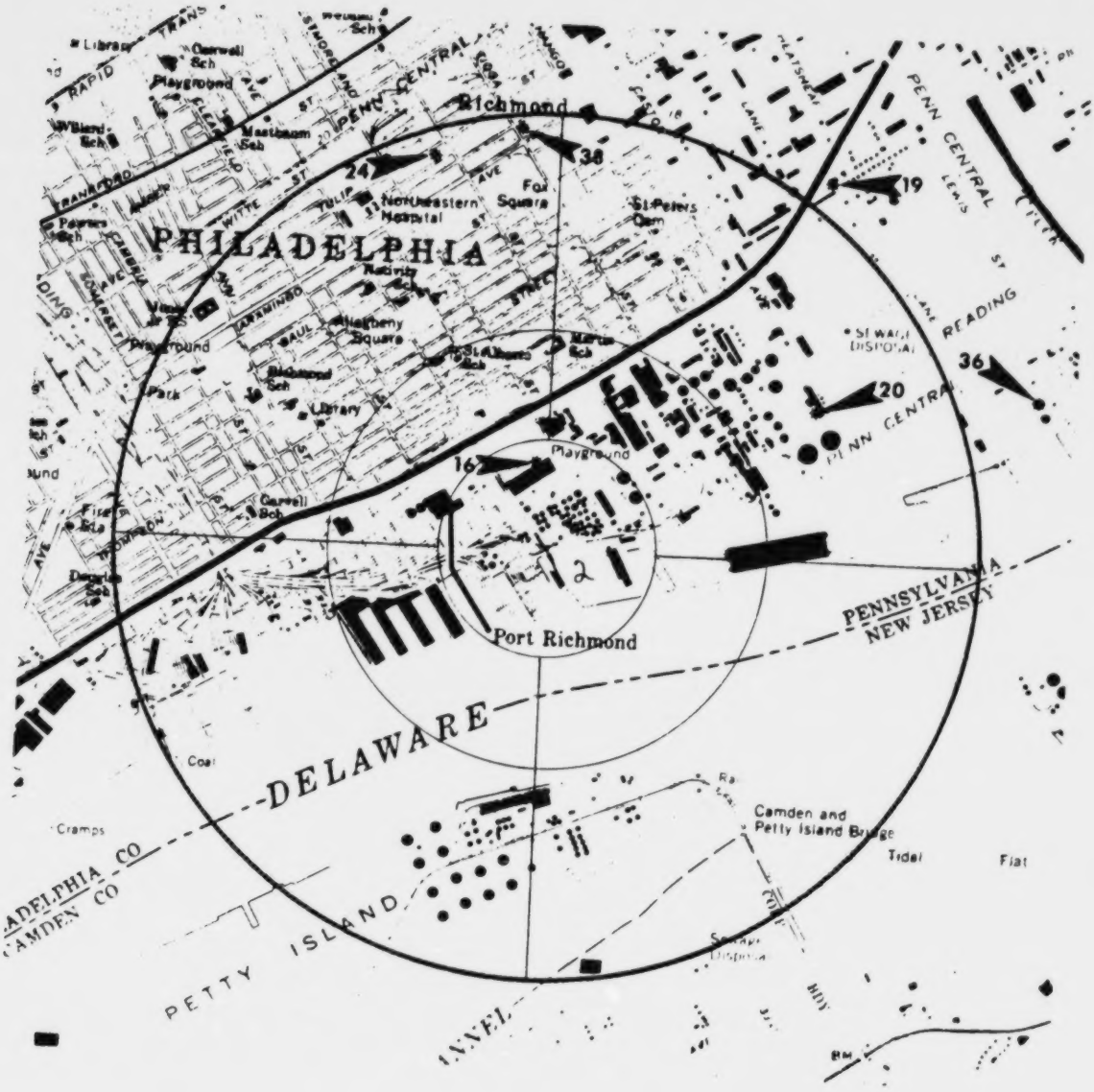
Topography - no special terrain

Localized sources, within 200 ft of monitor -

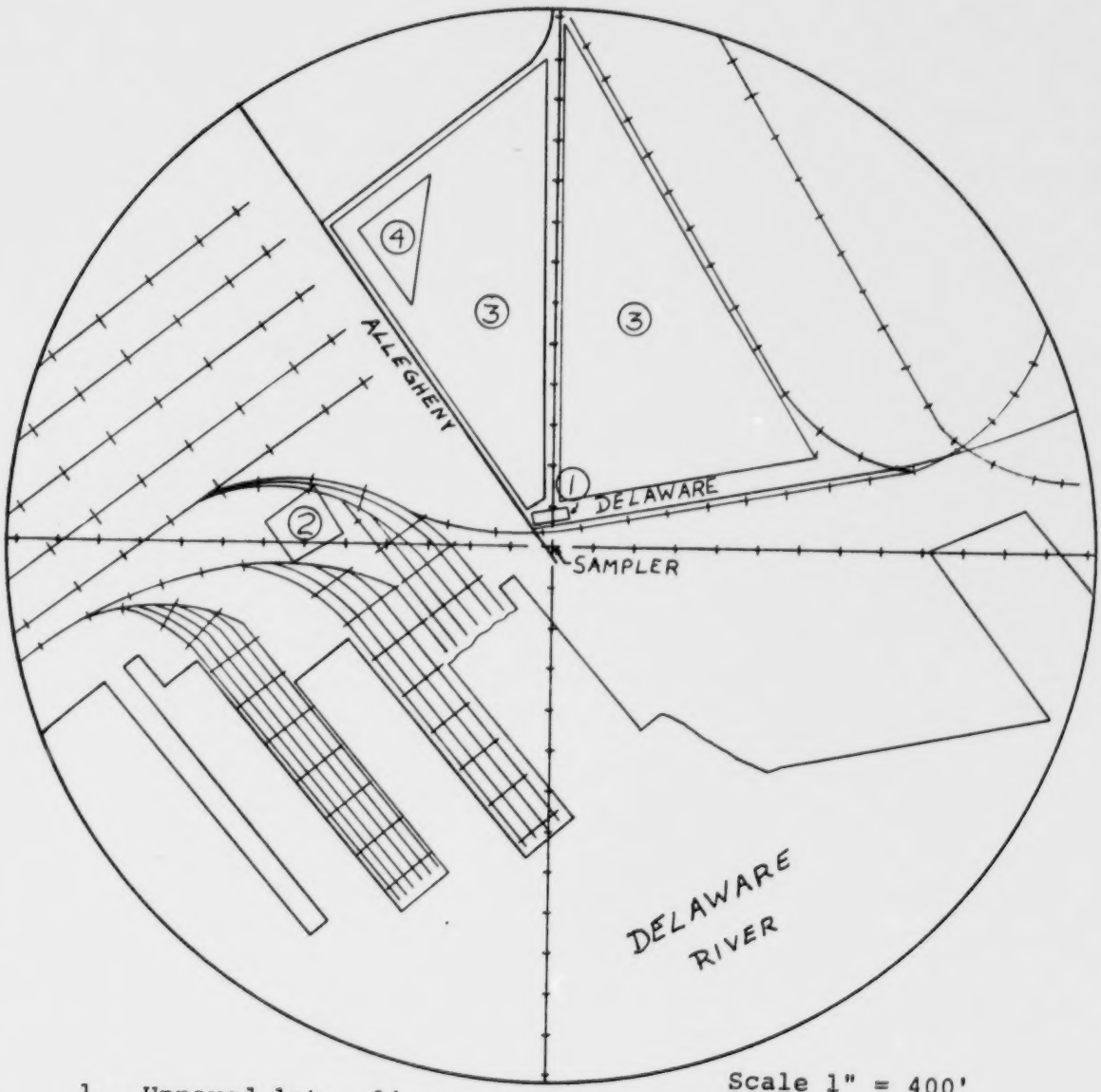
Source	Distance	Description
Parking lot	25 ft	unpaved, 0.04 acre, 5 cars
Allegheny Avenue	20 ft	20 ADT, clean, curbed
Delaware Avenue	65 ft	4900 ADT, 4 lane, clean, curbed

Air quality data -

Year	Annual geometric mean, ug/m^3	No. of samples
1976	104	This information was not available
1975	98	
1974	119	
1973	-	



One mile radius around Fireboat Station, Allegheny Avenue and Delaware River site.



Scale 1" = 400'

1. Unpaved lot, .04 acre, 5 cars
2. Exposed area, 1 acre
3. Unpaved storage, 3 acres
4. Scrap metal storage, 0.5 acre

One-quarter mile radius around Fireboat Station, Allegheny Avenue and Delaware River site.

Viewed to the southeast.

Viewed to the west-northwest.

Sampler at Fireboat Station, Allegheny Avenue and Delaware River.

POINT SOURCE SUMMARY

Site: Fireboat Station, Allegheny Avenue and Delaware River

Plant number	Emission level, t/yr	Distance from site, mi	Compass direction, °
16	300	.18	351
20	69	.72	56
47	26	.72	60
24	52	.88	342
38	37	.95	354
36	356	1.0	74
19	25	1.0	36
27	31	1.3	267
21	18	1.6	14
37	314	1.9	53
17	72	2.0	240
22	26	2.3	252
33	240	2.4	235
8	232	2.4	38
6	75	2.6	44
35	412	2.6	342
2	36	2.8	41
28	48	2.8	330
31	28	3.2	243
40	50	4.1	202
10	87	4.2	214
39	22	4.3	212
12	29	4.3	298
25	35	4.5	310
5	57	5.0	315

AREA SOURCE SUMMARY

Site: Fireboat Station, Allegheny Avenue and Delaware River

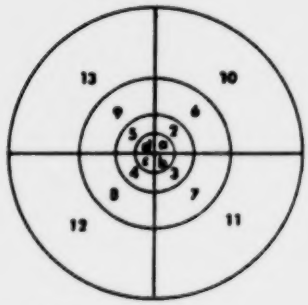
Source category	Activity rate	Emissions by sector, ton/yr									
		1	2	3	4	5	6	7	8	9	Total
COMBUSTION:											
Residential fuel						2.8	5.1			10.8	18.7
Comm/Ind fuel			4.2			4.2					8.4
Incinerators											
Rail/Air/Vessels		1.2		1.4	1.4		1.0	7.1	7.1	1.0	20.2
Auto exhaust	136.9×10^6 VMT	0.3	8.6			10.9	26.4		9.2	25.1	80.5
INDUS PROCESSES:											
Ind processes		2.0	10.0				19.0				31.0
FUGITIVE DUST:											
Railroad yards	88 ac	0.9			0.6	0.2			10.2	5.4	17.3
Clean streets	62.6×10^6 VMT	2.1	20.6			49.5	58.6		20.6	55.7	207.1
Comm streets	74.3×10^6 VMT		99.5			239.5	322.5		113.1	306.7	1081.3
Unpaved roads											
Cleared areas											
Construction											
Agriculture										0.8	0.8
Storage areas		0.4	0.4		5.7		1.6				8.1
Unpaved pkg lots			0.2		0.2						0.4

Recap	Emissions by sector, t/yr			
	1	2-5	6-9	Total
COMBUSTION	1.5	33.5	92.8	127.8
IND PROCESSES	2.0	10.0	19.0	31.0
FUGITIVE DUST	3.4	416.4	895.2	1315.0
Total	6.9	459.0	1007.0	1473.8

DESCRIPTION OF SITE

SAROAD code - 39 7140 021

Location - International Airport,
Island Road



Monitor height - 13 ft, on AMS trailer

Land use, by sector -

1a general industry
1b general industry
1c airport
1d undeveloped

2 undeveloped
3 general industry
4 undeveloped
5 undeveloped
6 undeveloped
7 undeveloped
8 undeveloped
9 undeveloped

10 heavy industry
11 undeveloped
12 general industry
13 general industry

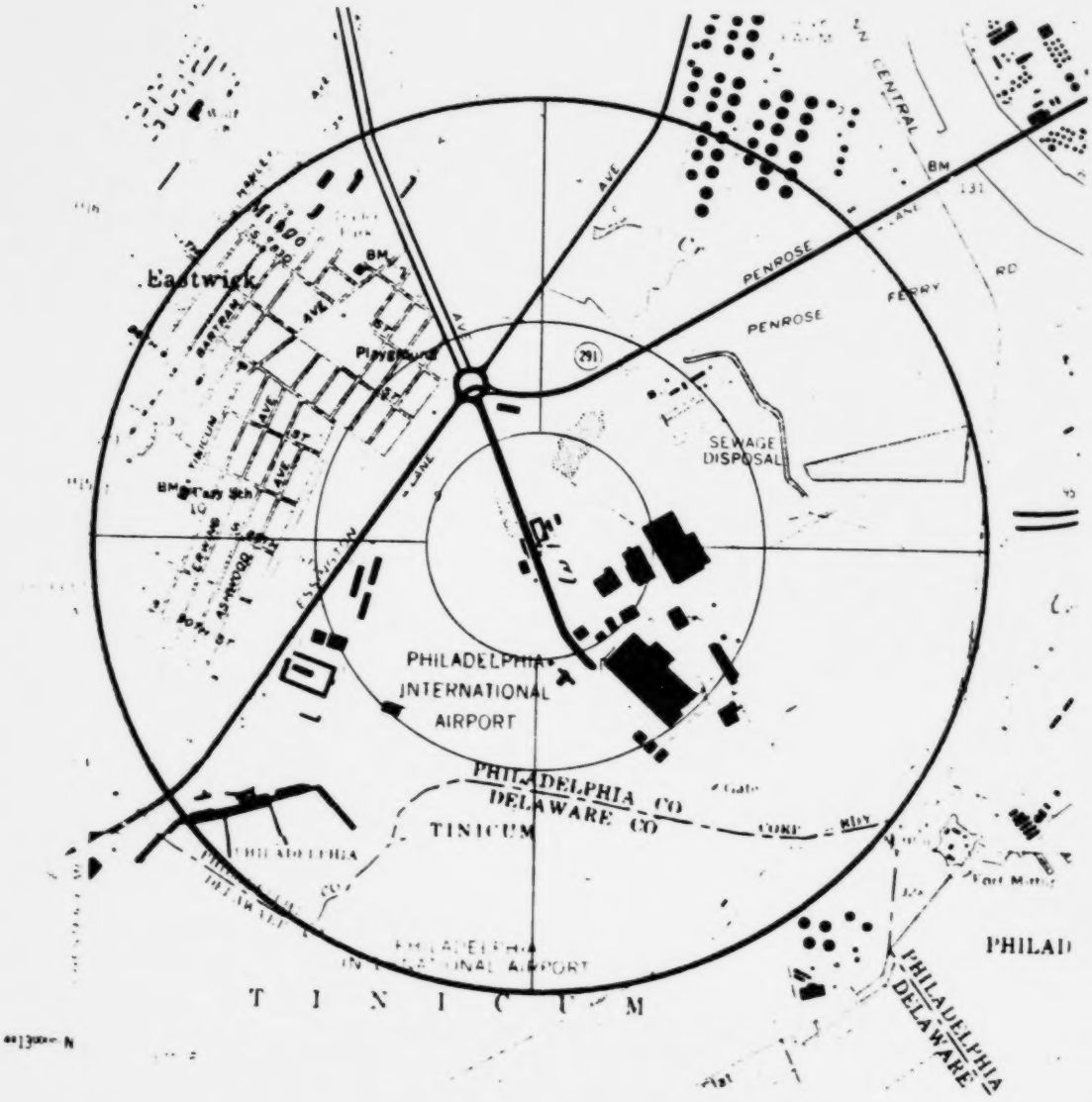
Topography - no special terrain

Localized sources, within 200 ft of monitor -

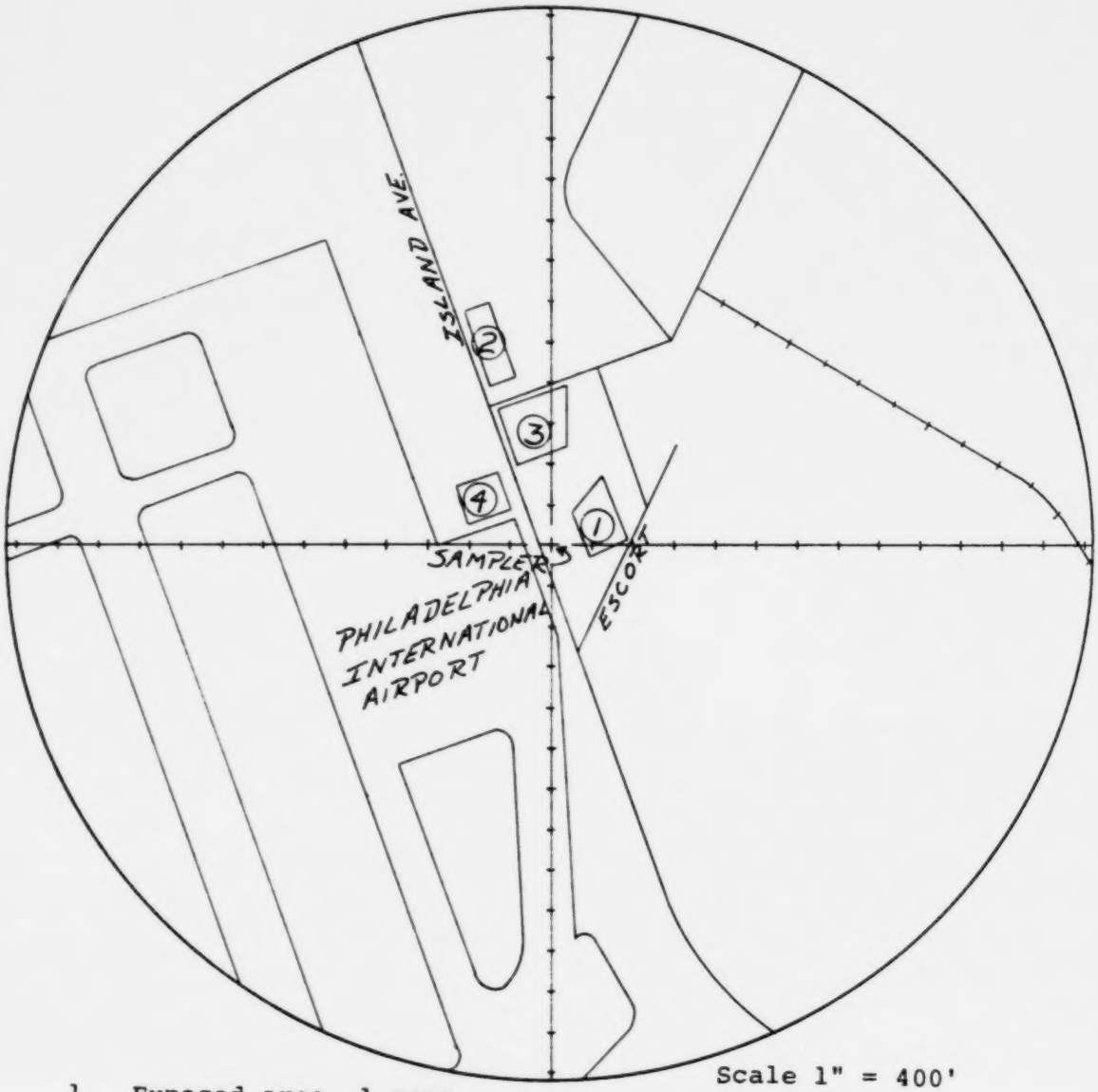
Source	Distance	Description
Exposed area	20 ft	0.02 acre
Philadelphia Street Department (storage)	120 ft	1 acre, exposed sand and dirt
Parking lot	100 ft	unpaved, 0.11 acre, 15 cars
Unpaved roads	40 ft	30 ADT, 2 lane, 70 ft long
Island Road	35 ft	6000 ADT, clean, curbed

Air quality data -

Year	Annual geometric mean, ug/m^3	No. of samples
1976	94	This information was not available
1975	97	
1974	94	
1973	-	



One mile radius around International Airport, Island Road site.



Scale 1" = 400'

1. Exposed area, 1 acre
2. Exposed area, 0.2 acre
3. Unpaved lot, 1 acre, 20 cars
4. Parking lot, 0.1 acre, 15 cars

One-quarter mile radius around International Airport, Island Road site.

Viewed to the north-northwest.

Viewed to the south-southeast.
Sampler at International Airport, Island Road.

POINT SOURCE SUMMARY

Site: International Airport, Island Road

Plant number	Emission level, t/yr	Distance from site, mi	Compass direction, °
3	505	1.9	29
23	880	2.4	55
4	343	2.7	82
15	58	3.2	16
32	29	3.4	40
1	477	3.5	30
42	155	3.6	151
18	57	4.1	22
30	103	4.6	30
29	63	4.7	85

AREA SOURCE SUMMARY

Site: International Airport, Island Road

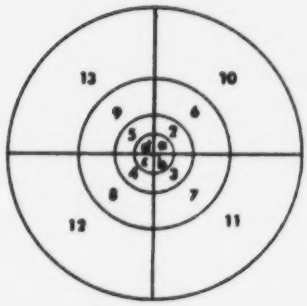
Source category	Activity rate	Emissions by sector, ton/yr									
		1	2	3	4	5	6	7	8	9	Total
COMBUSTION:											
Residential fuel		0.2				0.3				0.8	1.3
Comm/Ind fuel											
Incinerators											
Rail/Air/Vessels		8.1	6.0	6.0	6.0		24.1	24.1	24.1		98.4
Auto exhaust	127×10^6 VMT	0.7	13.6	0.4	2.3	16.2	18.8	4.8	16.6	10.3	83.7
INDUS PROCESSES:											
Ind processes		1.0							6.0		7.0
FUGITIVE DUST:											
Railroad yards											
Clean streets	127×10^6 VMT	3.6	68.1	2.2	11.6	81.0	94.2	24.2	83.0	51.7	419.6
Comm streets											
Unpaved roads											
Cleared areas	76.7 ac						1.3	0.2			1.5
Construction	20.5 ac		7.6			2.1	2.5	2.5	1.7	0.8	17.2
Agriculture											
Storage areas	24 ac										
Unpaved pkg lots	1.2 ac	0.3									0.3

Recap	Emissions by sector, t/yr			
	1	2-5	6-9	Total
COMBUSTION	9.0	50.8	123.6	183.4
IND PROCESSES	1.0		6.0	7.0
FUGITIVE DUST	3.9	172.6	262.1	438.6
Total	13.9	223.4	391.7	629.0

DESCRIPTION OF SITE

SAROAD code - 39 7140 014

Location - Roxborough Water Pump Station



Monitor height - 13 ft, on AMS trailer

Land use, by sector -

1a light residential
1b light residential
1c undeveloped
1d undeveloped

2 dense residential
3 dense residential
4 undeveloped
5 undeveloped
6 dense residential
7 dense residential
8 undeveloped
9 undeveloped

10 undeveloped
11 dense residential
12 dense residential
13 undeveloped

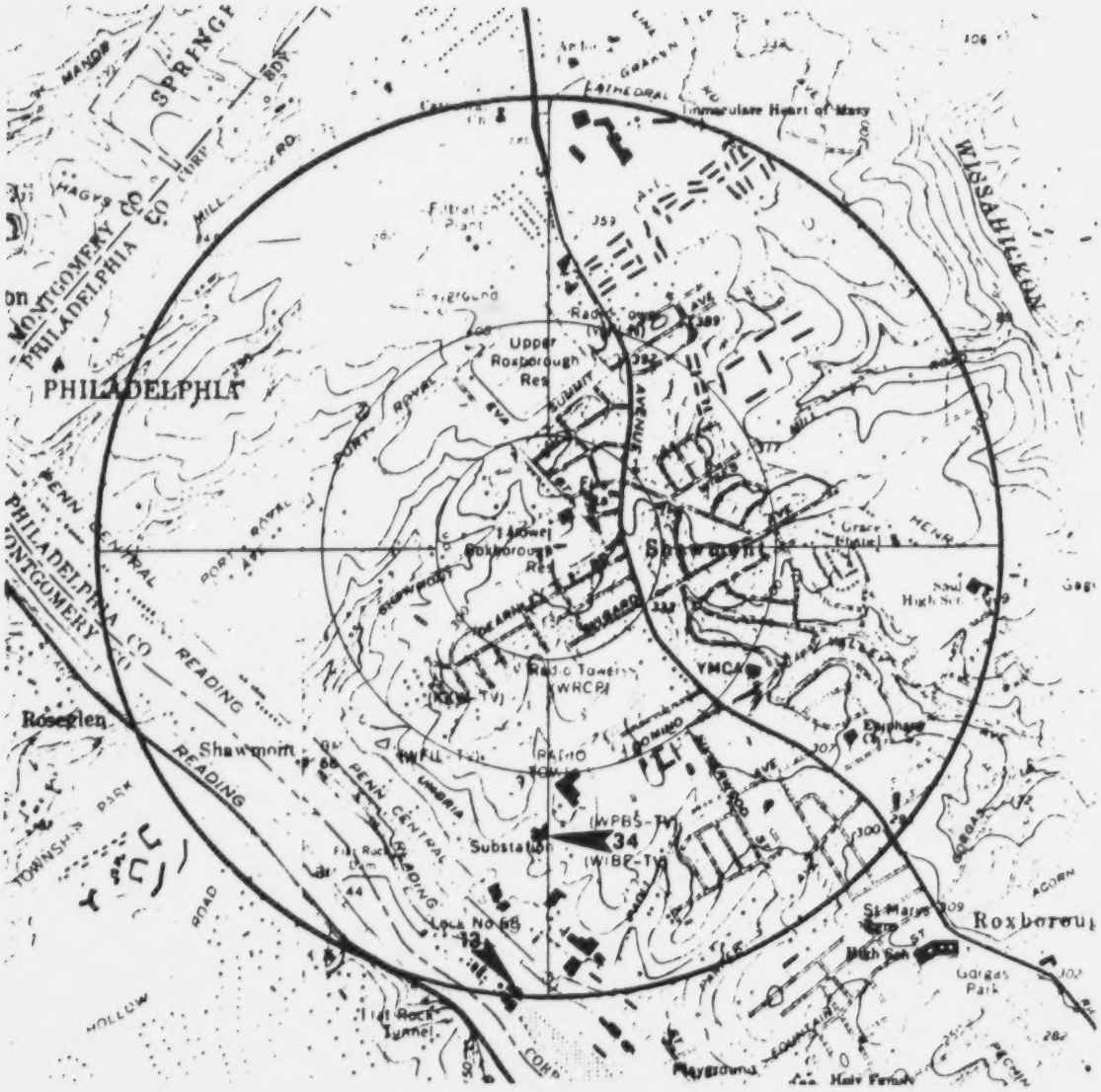
Topography - no special terrain

Localized sources, within 200 ft of monitor -

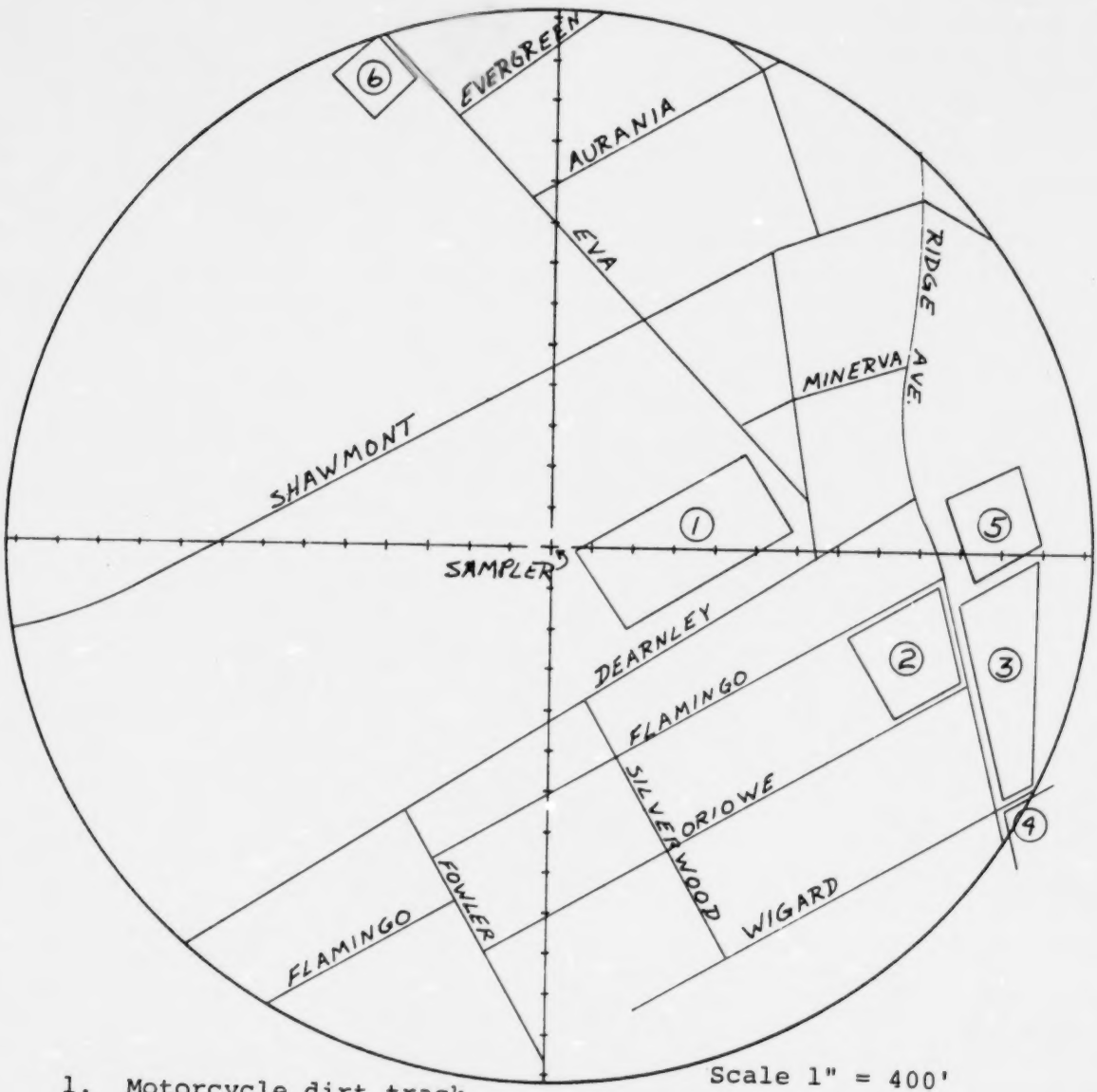
Source	Distance	Description
Motorcycle dirt track	50-250 ft	30 ADT, 0.25 mile

Air quality data -

Year	Annual geometric mean, ug/m^3	No. of samples
1976	56	This information was not available
1975	53	
1974	59	
1973	-	



One mile radius around Roxborough Water Pump Station site.



Scale 1" = 400'

1. Motorcycle dirt track
2. Construction, 0.25 acre
3. Exposed area, 0.1 acre
4. Construction, 2 acres
5. Exposed area, 1 acre
6. Exposed area, 0.5 acre

One-quarter mile radius around Roxborough Water Pump Station site.

Viewed to the southeast.

Viewed to the southwest.
Sampler at Roxborough Water Pump Station.

POINT SOURCE SUMMARY

Site: Roxborough Water Pump Station

Plant number	Emission level, t/yr	Distance from site, mi	Compass direction,°
34	160	.68	185
13	66	1.0	190
5	57	4.1	131
12	29	4.6	128
25	35	4.6	115

AREA SOURCE SUMMARY

Site: Roxborough Water Pump Station

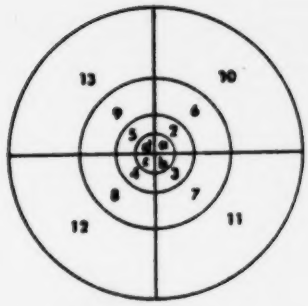
Source category	Activity rate	Emissions by sector, ton/yr									
		1	2	3	4	5	6	7	8	9	Total
COMBUSTION:											
Residential fuel		1.0	0.7	0.7	0.7		2.9	2.9			8.9
Comm/Ind fuel		0.1	0.1	0.1	0.1	0.1	0.4	0.4	0.4	0.4	2.1
Incinerators											
Rail/Air /Vessels									0.7	0.6	1.3
Auto exhaust	26.7×10^6 VMT	1.7	1.1	1.1	0.6		5.9	3.6	2.7	0.9	17.6
INDUS PROCESSES:											
Ind processes								1.0			1.0
FUGITIVE DUST:											
Railroad yards	17 ac									0.7	0.7
Clean streets	26.7×10^6 VMT	8.6	5.4	5.5	3.1		29.4	18.3	13.6	4.3	88.2
Comm streets											
Unpaved roads	0.25 mi	0.6									0.6
Cleared areas	9.6 ac	0.1					0.1				0.2
Construction	7.2 ac	1.9								4.2	6.1
Agriculture											
Storage areas	0.5 ac							0.1	0.7		0.8
Unpaved pkg lots	2.0 ac							0.9	0.1	0.2	1.2

Recap	Emissions by sector, t/yr			
	1	2-5	6-9	Total
COMBUSTION	2.8	5.3	21.8	29.9
IND PROCESSES			1.0	1.0
FUGITIVE DUST	11.2	14.0	72.6	97.8
Total	14.0	19.3	95.4	128.7

DESCRIPTION OF SITE

SAROAD code - 39 7140 024

Location - Northeast Airport, Grant Avenue and Ashton Road



Monitor height - 13 ft, on AMS trailer

Land use, by sector -

1a airport	6 light industry
1b airport	7 dense residential
1c undeveloped	8 light industry
1d undeveloped	9 light industry
2 light industry	10 light industry
3 dense residential	11 dense residential
4 light industry	12 dense residential
5 light industry	13 dense residential

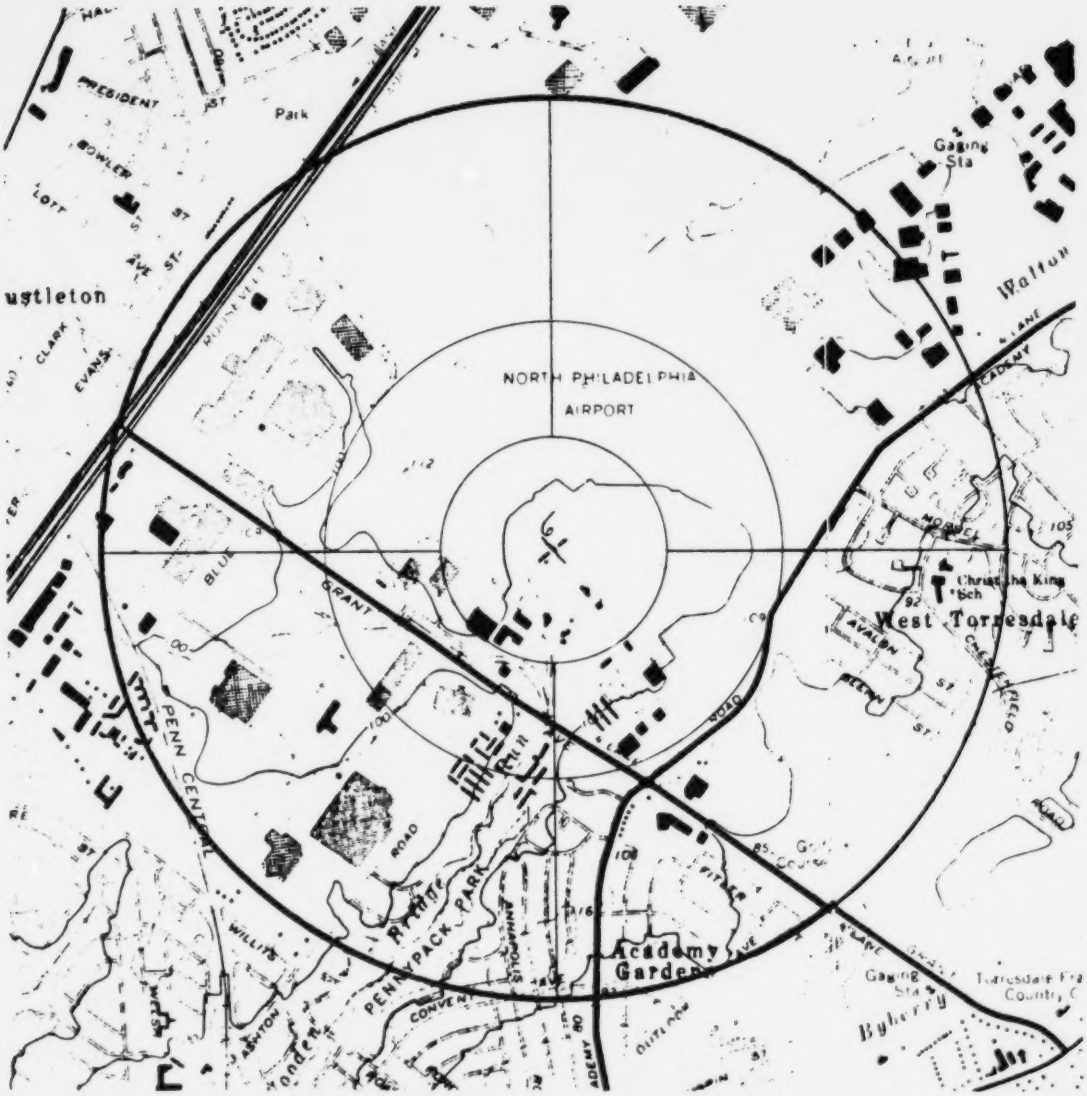
Topography - no special terrain

Localized sources, within 200 ft of monitor -

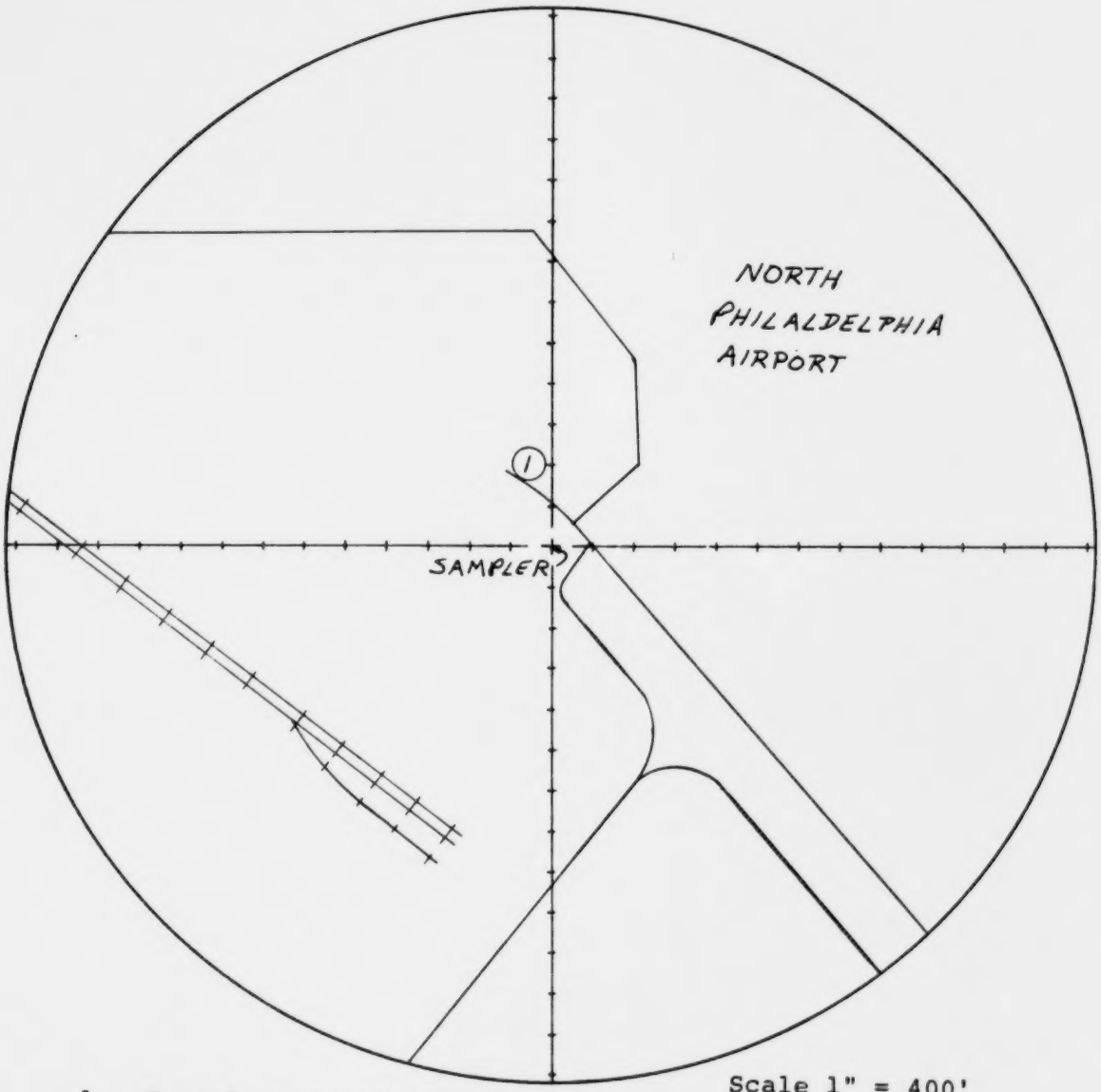
Source	Distance	Description
Gravel road	50 ft	10 ADT, 150 ft long
Helicopter landing area	30 ft	fugitive dust from exposed area

Air quality data -

Year	Annual geometric mean, ug/m^3	No. of samples
1976	56	This information was not available
1975	62	
1974	64	
1973	-	



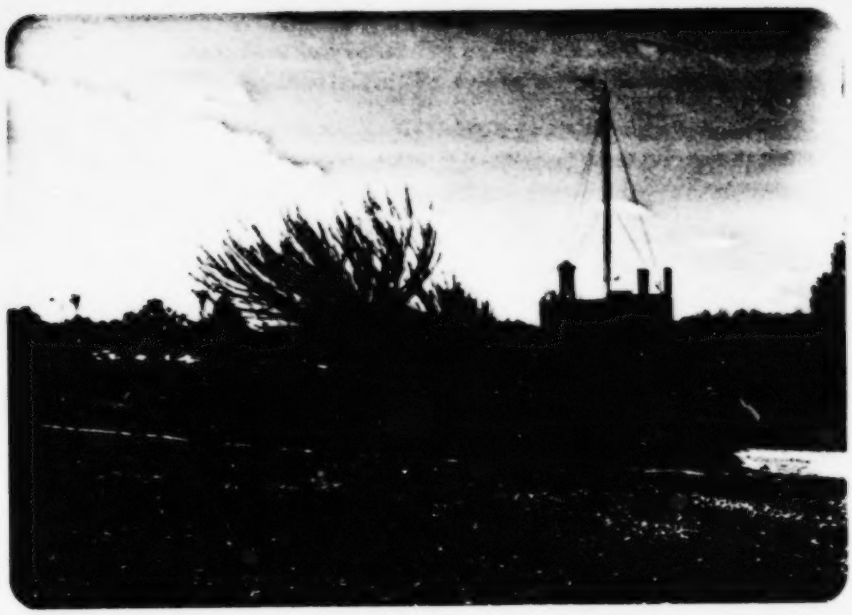
One mile radius around Northeast Airport, Grant Avenue and Ashton Road site.



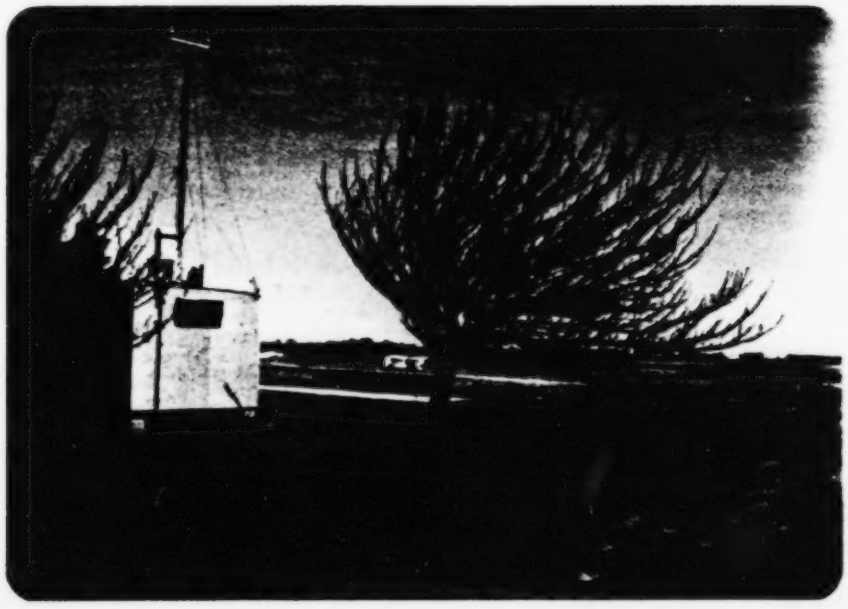
1. Gravel road, 150 ft, 10 cars

Scale 1" = 400'

One-quarter mile radius around Northeast Airport, Grant Avenue and Ashton Road site.



Viewed to the southwest.



Viewed to the northeast.
Sampler at Northeast Airport, Grant Avenue and Ashton Road.

POINT SOURCE SUMMARY

Site: Northeast Airport, Grant Avenue and Ashton Road

Plant number	Emission level, t/yr	Distance from site, mi	Compass direction, °
7	99	2.6	16
9	52	2.7	191
11	39	2.8	330

AREA SOURCE SUMMARY

Site: Northeast Airport, Grant Avenue and Ashton Road

Source category	Activity rate	Emissions by sector, ton/yr									
		1	2	3	4	5	6	7	8	9	Total
COMBUSTION:											
Residential fuel							2.2	6.6			8.8
Comm/Ind fuel				0.2	0.2	0.2	2.1				2.7
Incinerators											
Rail/Air/Vessels		3.0	2.2	2.2	2.2	2.2	9.0	9.0	9.0	9.0	47.8
Auto exhaust	57.6×10^6 VMT			0.4	4.0		3.6	9.3	1.9	18.7	37.9
INDUS PROCESSES:											
Ind processes					5.0		13.0		2.0	14.0	34.0
FUGITIVE DUST:											
Railroad yards											
Clean streets	57.6×10^6 VMT			2.2	20.3		18.2	46.7	9.3	93.7	190.4
Comm streets											
Unpaved roads	104VMT	0.1									0.1
Cleared areas	3 ac							0.1			0.1
Construction	4 ac								3.4		3.4
Agriculture											
Storage areas	1.5 ac							0.1	0.7		0.8
Unpaved pkg lots											

Recap	Emissions by sector, t/yr			
	1	2-5	6-9	Total
COMBUSTION	3.0	13.8	80.4	97.2
IND PROCESSES		5.0	29.0	34.0
FUGITIVE DUST	0.1	22.5	172.2	194.8
Total	3.1	41.3	281.6	326.0

DESCRIPTION OF SITE

SAROAD code - 39 7140 002

Location - North Broad Street and
Germantown

Monitor height - 15 ft, on AMS trailer

Land use, by sector -

1a dense residential
1b dense residential
1c dense residential
1d dense residential

2 dense residential
3 dense residential
4 dense residential
5 dense residential
6 light industry
7 dense residential
8 dense residential
9 dense residential

10 dense residential
11 dense residential
12 dense residential
13 dense residential

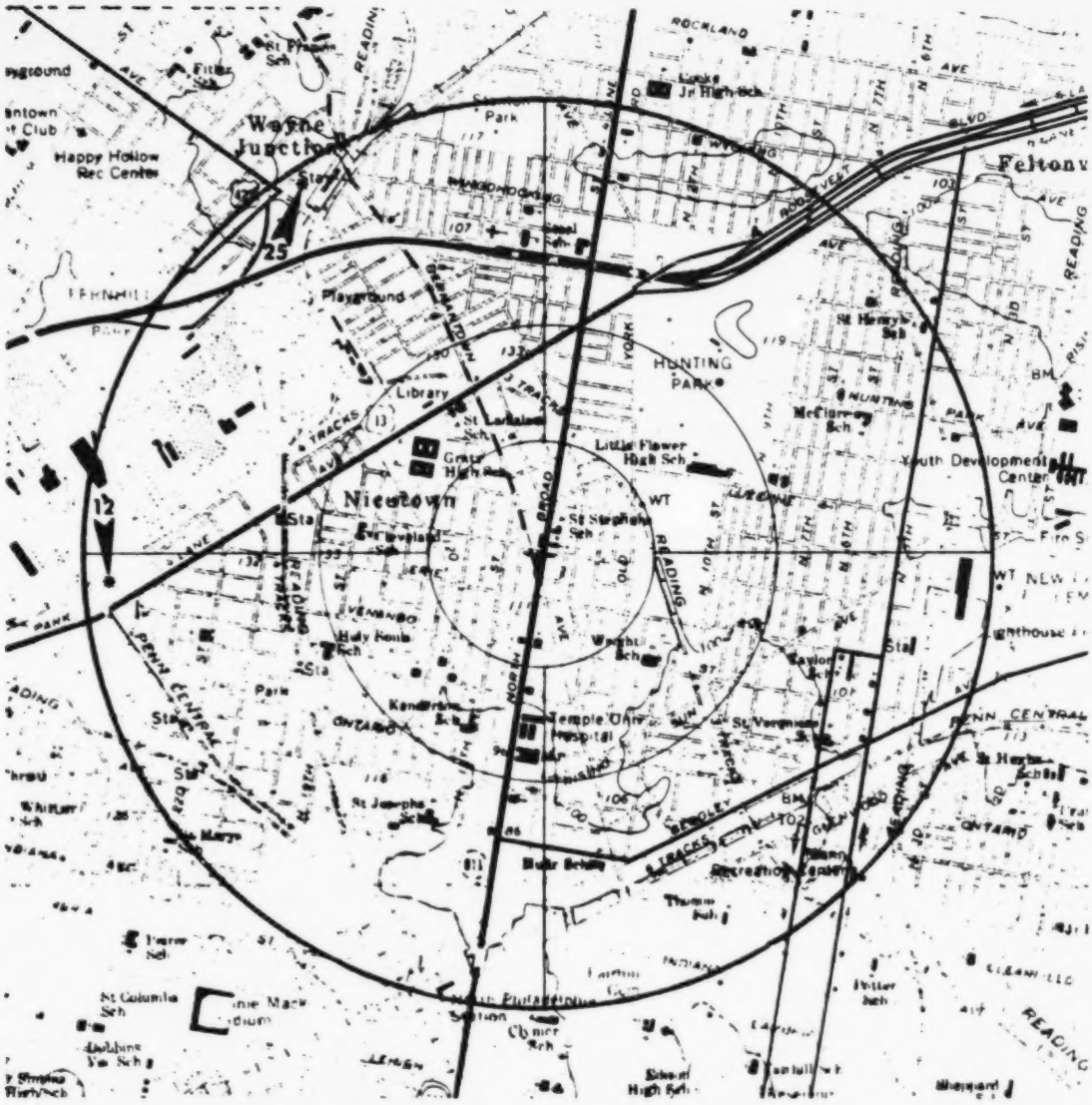
Topography - no special terrain

Localized sources, within 200 ft of monitor -

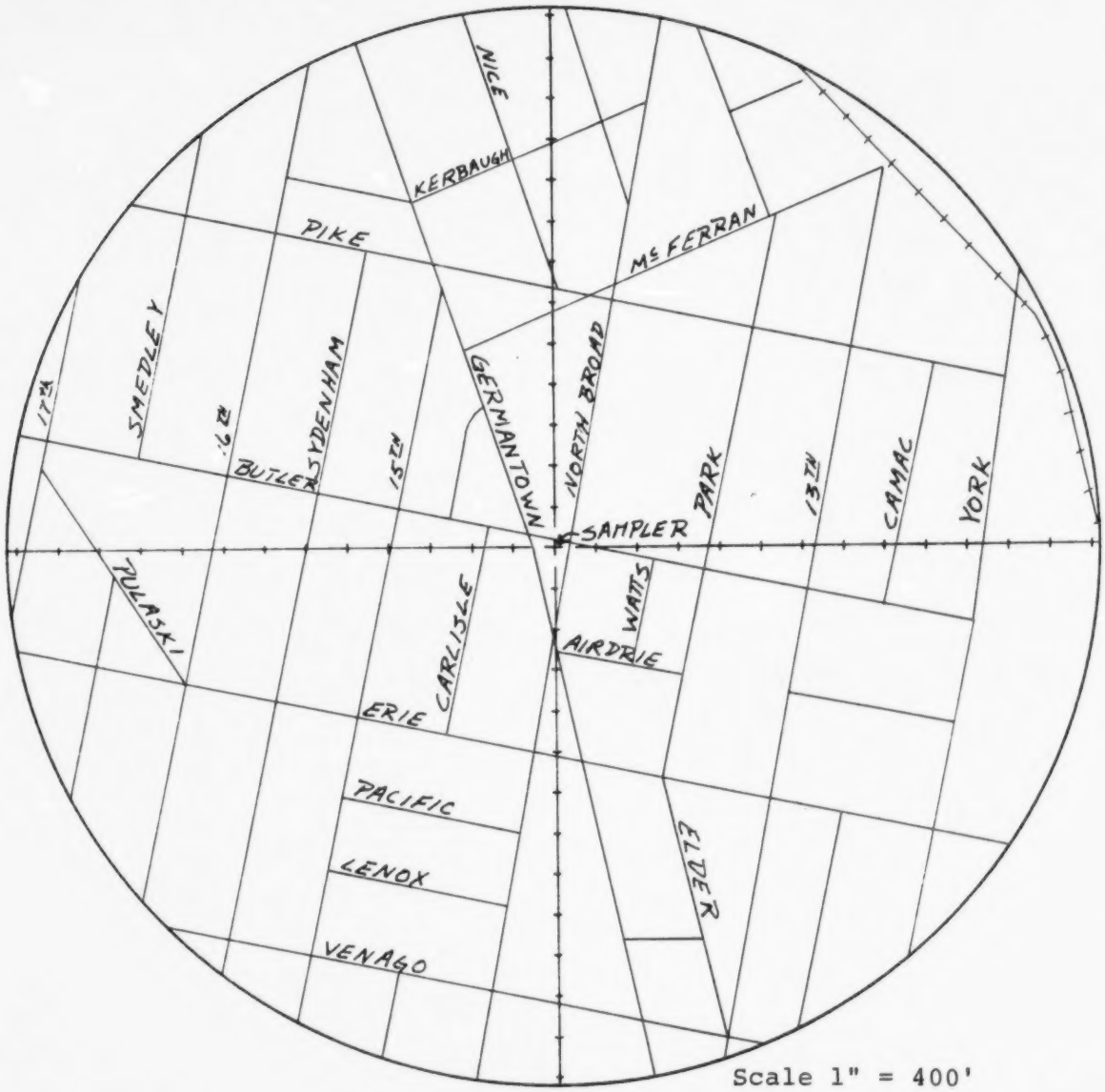
Source	Distance	Description
Germantown	55 ft	7000 ADT, clean, curbed
North Broad	30 ft	40,500 ADT, clean, curbed
Butler Street	25 ft	5000 ADT, clean, curbed
Carlisle Street	180 ft	800 ADT, clean, curbed

Air quality data -

Year	Annual geometric mean, ug/m^3	No. of samples
1976	103	This information was not available
1975	105	
1974	-	
1973	-	



One mile radius around North Broad Street and Germantown site.



Scale 1" = 400'

One-quarter mile radius around North Broad Street and Germantown site.

Viewed to the east-northeast.

Viewed to the north.
Sampler at North Broad Street and Germantown.

POINT SOURCE SUMMARY

Site: North Broad Street and Germantown

Plant number	Emission level, t/yr	Distance from site, mi	Compass direction, °
25	35	.96	330
12	29	.98	270
28	48	1.5	84
5	57	1.6	270
35	412	2.1	80
27	31	2.7	149
24	52	2.9	120
22	26	3.0	168
38	37	3.1	116
21	28	3.2	103
17	72	3.3	164
16	300	3.4	128
31	28	3.5	183
33	240	3.6	168
19	25	3.7	114
20	69	3.8	120
8	232	4.3	97
36	356	4.3	119
37	314	4.4	106
2	36	4.6	92
6	75	4.6	96

AREA SOURCE SUMMARY

Site: North Broad Street and Germantown

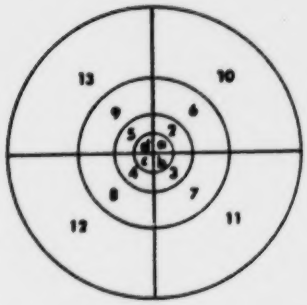
Source category	Activity rate	Emissions by sector, ton/yr									
		1	2	3	4	5	6	7	8	9	Total
COMBUSTION:											
Residential fuel		3.4	2.5	2.5	2.5	2.5	10.1	10.1	10.1	10.1	53.8
Comm/Ind fuel						3.4				13.8	17.2
Incinerators											
Rail/Air/Vessels		1.2	0.9	0.9	0.9	0.9	3.7	3.7	3.7	3.7	19.6
Auto exhaust	121.3×10^6 VMT	6.1	2.7	3.5	0.4	2.7	17.9	7.5	11.1	15.4	67.3
INDUS PROCESSES:											
Ind processes							6.0	14.0	9.0	23.0	52.0
FUGITIVE DUST:											
Railroad yards	89 ac						0.1	0.6	0.4	2.4	3.5
Clean streets	98.6×10^6 VMT	30.5	13.8	16.1	2.1	13.4	89.7	36.0	50.6	76.9	329.1
Comm streets	22.7×10^6 VMT			7.1				7.9	2.2		17.2
Unpaved roads											
Cleared areas	2.0 ac										
Construction											
Agriculture											
Storage areas	1.8 ac							0.2			0.2
Unpaved pkg lots	1.2 ac								5.0		5.0

Recap	Emissions by sector, t/yr			
	1	2-5	6-9	Total
COMBUSTION	10.7	26.3	120.9	157.9
IND PROCESSES			52.0	52.0
FUGITIVE DUST	30.5	52.5	272.0	355.0
Total	41.2	78.8	444.9	564.9

DESCRIPTION OF SITE

SAROAD code - 39 7140 002

Location - Franklin Institute,
20th and Parkway



Monitor height - 50 ft, on Franklin Institute

Land use, by sector -

1a central commercial	6 dense residential
1b central commercial	7 central commercial
1c central commercial	8 central commercial
1d central commercial	9 dense residential
2 central commercial	10 dense residential
3 central commercial	11 dense residential
4 central commercial	12 heavy industry
5 dense residential	13 dense residential

Topography - no special terrain

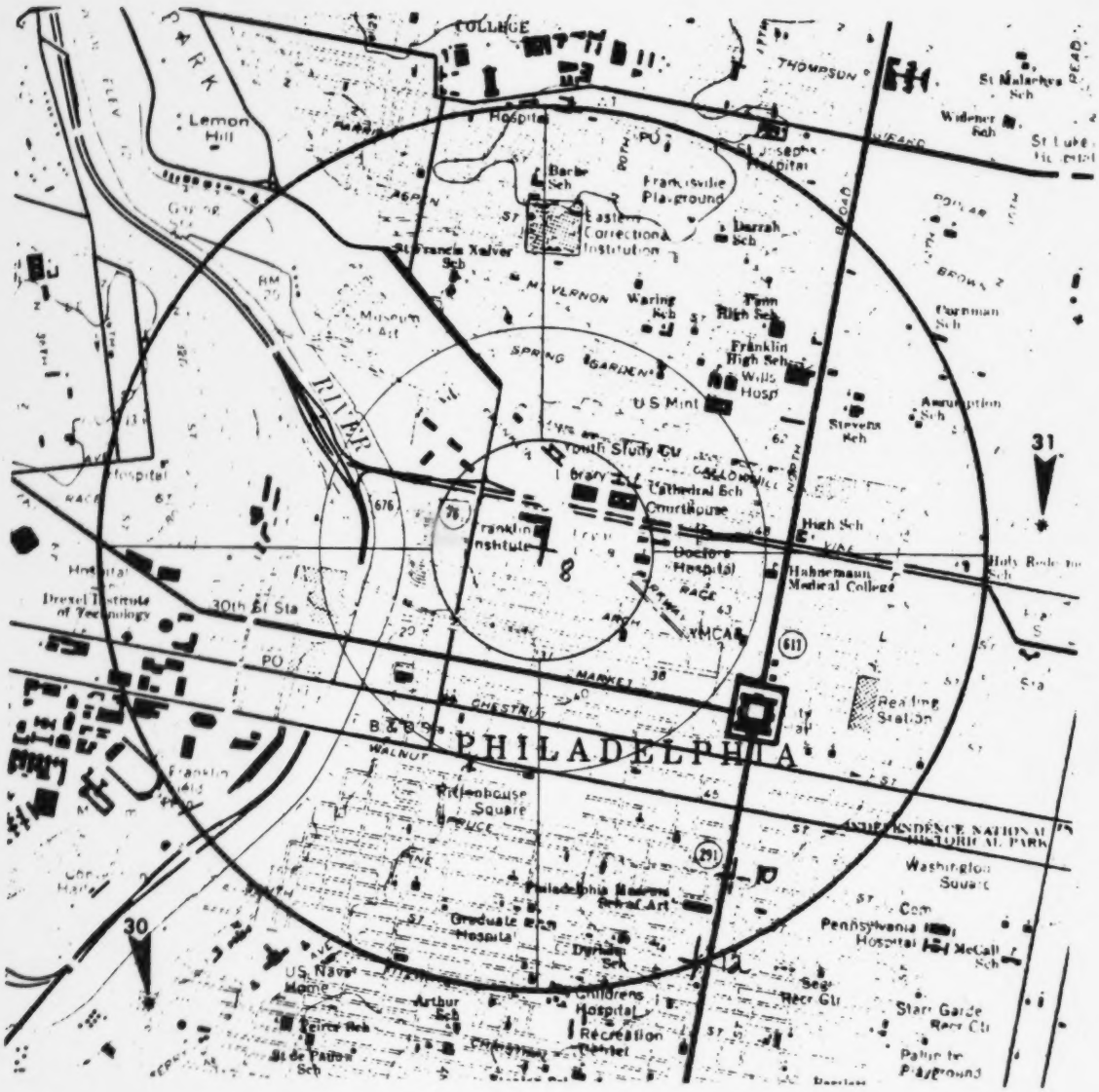
Localized sources, within 200 ft of monitor -

Source	Distance	Description
Rail Street	50 ft	3000 ADT, clean, curbed
20th Street	100 ft	8600 ADT, clean, curbed
Street	100 ft	800 ADT, clean, curbed

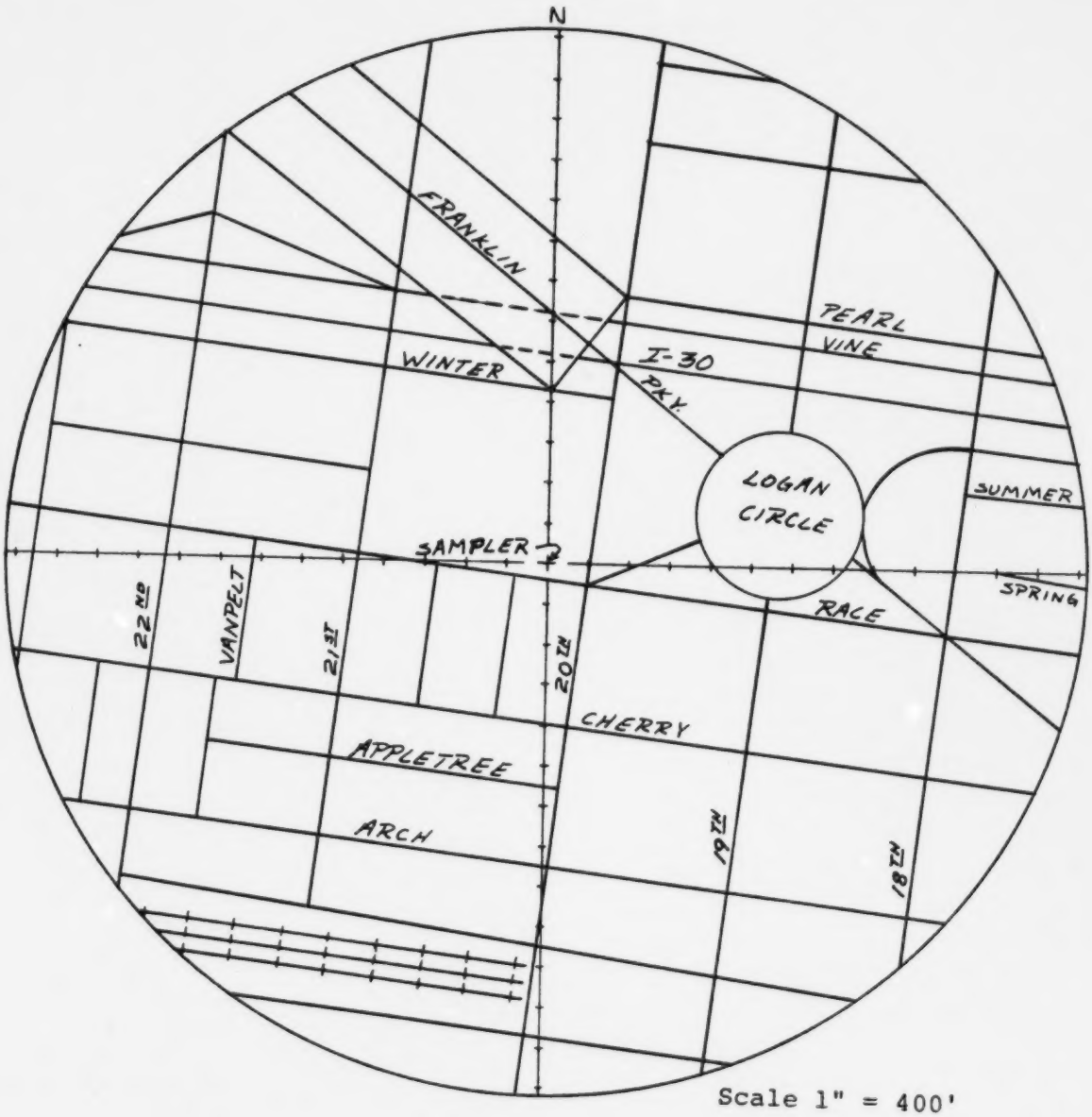
Air quality data -

Year	Annual geometric mean, ug/m^3	No. of samples
1976	81	This information
1975	94	was not available
1974[a]	19	
1973	-	

[a] Site moved at end of 1974 from ground level to present height.



One mile radius around Franklin Institute, 20th and Parkway site.



Scale 1" = 400'

One-quarter mile radius around Franklin Institute, 20th Parkway site.

Viewed to the east-southeast.

Viewed to the west-northwest.
Sampler at Franklin Institute, 20th and Parkway.

POINT SOURCE SUMMARY

Site: Franklin Institute, 20th and Parkway

Plant number	Emission level, t/yr	Distance from site, mi	Compass direction, °
31	28	1.1	90
30	103	1.3	220
22	26	1.9	71
33	240	1.9	88
18	57	2.0	229
17	72	2.2	82
1	477	2.4	214
32	29	2.5	201
10	87	2.5	143
39	25	2.8	144
15	58	2.9	226
27	31	2.9	64
40	50	3.3	135
12	29	3.5	4
5	57	3.6	352
23	880	3.8	295
3	506	4.0	211
14	120	4.0	153
16	300	4.3	69
4	343	4.2	189
24	52	4.4	59
25	35	4.5	8
38	37	4.6	58
29	63	4.6	161
28	48	4.6	35
20	65	4.9	70

AREA SOURCE SUMMARY

Site: Franklin Institute, 20th and Parkway

Source category	Activity rate	Emissions by sector, ton/yr									
		1	2	3	4	5	6	7	8	9	Total
COMBUSTION:											
Residential fuel		4.0	3.0	3.0	3.0	3.0	12.1	12.1	12.1	12.1	64.4
Comm/Ind fuel		1.1	0.8	0.8	0.8	0.8	3.4	3.4	3.4	3.4	17.9
Incinerators											
Rail/Air/Vessels		0.8	0.6	0.6	0.6	0.6	2.2	2.2	2.2	2.2	12.0
Auto exhaust	202×10^6 VMT	11.8	3.9	5.6	11.7	11.0	3.6	29.3	29.5	26.8	133.2
INDUS PROCESSES:											
Ind processes							8.0	1.0		4.0	13.0
FUGITIVE DUST:											
Railroad yards	63 ac		0.1		0.2	0.2	0.1	0.1	0.2	1.6	2.5
Clean streets	202×10^6 VMT	58.9	19.7	27.8	58.6	55.3	17.9	146.7	147.6	134.1	666.6
Comm streets											
Unpaved roads											
Cleared areas	2.7 ac										
Construction	1 ac							0.8			0.8
Agriculture											
Storage areas											
Unpaved pkg lots	1.8 ac		0.1	0.1			1.2				1.4

Recap	Emissions by sector, t/yr			
	1	2-5	6-9	Total
COMBUSTION	17.7	49.8	160.0	227.5
IND PROCESSES			13.0	13.0
FUGITIVE DUST	58.9	162.1	450.3	671.3
Total	76.6	211.9	623.3	911.8

DESCRIPTION OF SITE

SAROAD code - 39 7140 004

Location - 1501 East Lycoming Avenue

Monitor height - 17 ft, on gravel roof

Land use, by sector -

1a dense residential
1b dense residential
1c dense residential
1d dense residential

2 dense residential
3 light residential
4 dense residential
5 dense residential
6 dense residential
7 light residential
8 dense residential
9 dense residential

10 dense residential
11 general industry
12 dense residential
13 dense residential

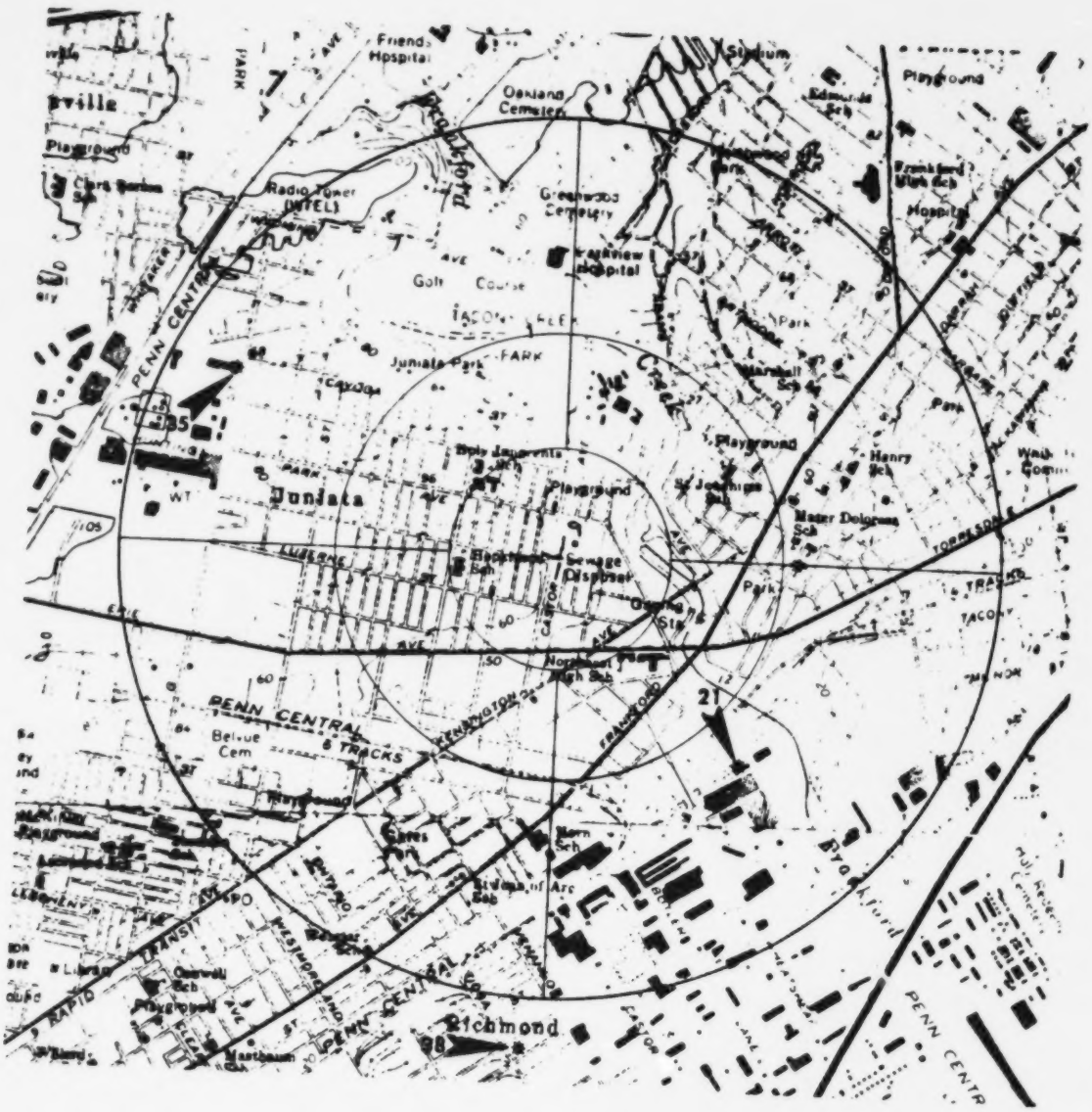
Topography - no special terrain

Localized sources, within 200 ft of monitor -

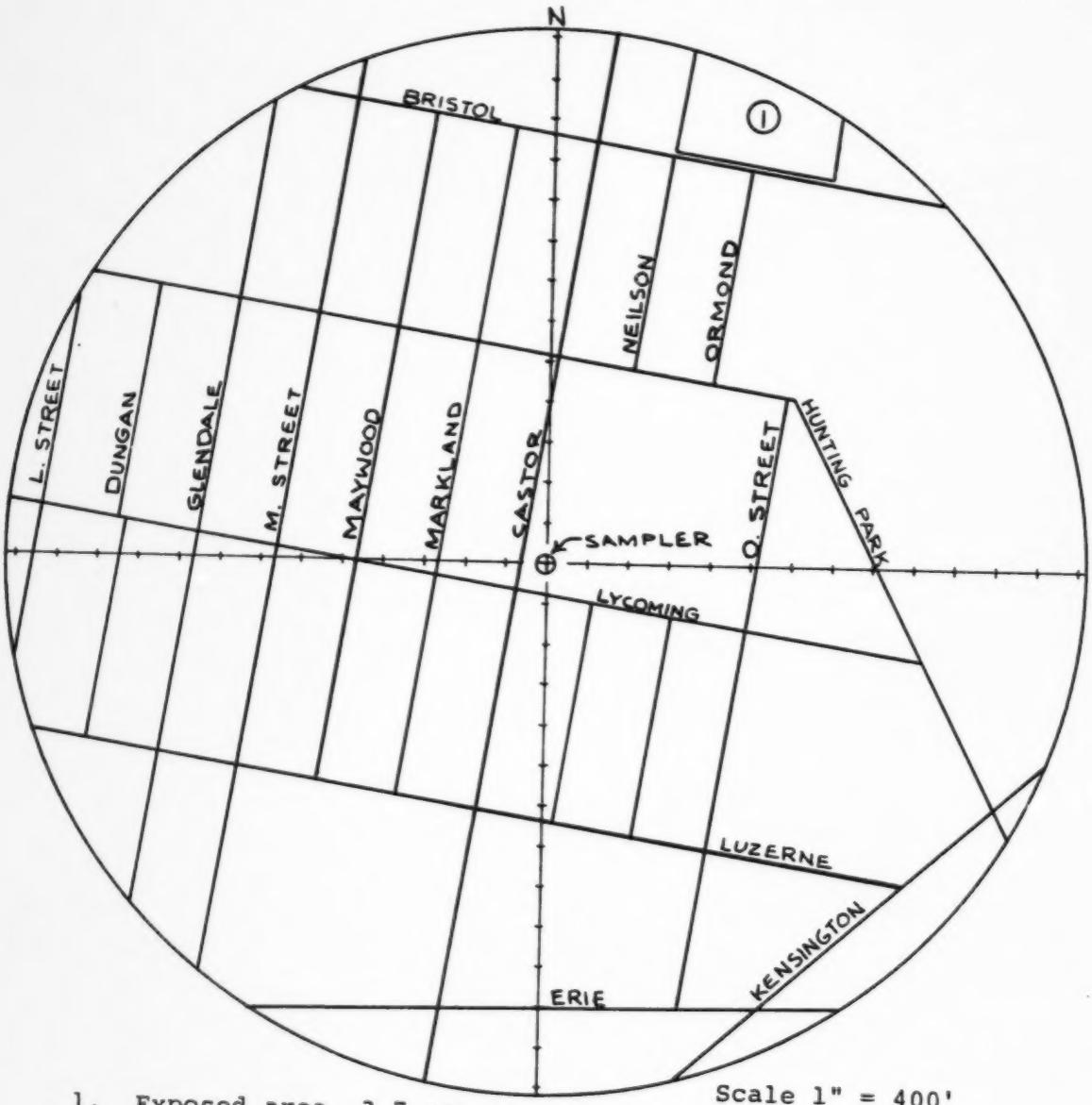
Source	Distance	Description
Castor Street	40 ft	14,000 ADT, clean, curbed
Neilson Street	50 ft	100 ADT, clean, curbed
Lycoming Street	40 ft	1500 ADT, clean, curbed

Air quality data -

Year	Annual geometric mean, ug/m^3	No. of samples
1976	75	This information was not available
1975	69	
1974	78	
1973	84	



One mile radius around 1501 East Lycoming Avenue site.



1. Exposed area, 3.7 acres

Scale 1" = 400'

One-quarter mile radius around 1501 East Lycoming Avenue site.

Viewed to the north.

Viewed to the south-southwest.
Sampler at 1501 East Lycoming Avenue.

POINT SOURCE SUMMARY

Site: 1501 East Lycoming Avenue

Plant number	Emission level, t/yr	Distance from site, mi	Compass direction, °
21	28	.59	137
35	412	.85	301
38	37	1.1	186
24	52	1.2	191
28	48	1.3	284
19	25	1.4	150
8	124	1.5	99
2	36	1.8	89
6	75	1.8	98
37	314	1.8	123
20	69	1.8	158
16	300	1.8	181
36	356	2.0	149
27	31	2.5	210
17	72	3.5	209
22	26	3.5	216
25	35	3.5	285
12	29	3.7	271
33	240	3.9	209
5	57	4.4	272
9	52	4.6	67

AREA SOURCE SUMMARY

Site: 1501 East Lycoming Avenue

Source category	Activity rate	Emissions by sector, ton/yr									
		1	2	3	4	5	6	7	8	9	Total
COMBUSTION:											
Residential fuel		1.9	1.4	1.4	1.4	1.4	5.8	5.8	5.8	5.8	30.7
Comm/Ind fuel		0.6	0.4	0.4	0.4	0.4	1.6	1.6	1.6	1.6	8.6
Incinerators											
Rail/Air /Vessels		6.8	5.1	5.1	5.1	5.1	20.2	20.2	20.2	20.2	108.0
Auto exhaust	62.5×10^6 VMT	4.7	0.6	2.0	2.3	1.3	3.8	10.0	6.7	9.8	41.2
INDUS PROCESSES:											
Ind processes		2.0	17.0	18.0	20.0		17.0	26.0	28.0	4.0	132.0
FUGITIVE DUST:											
Railroad yards	25 ac						1.0				1.0
Clean streets	62.5×10^6 VMT	23.6	2.9	10.0	11.8	6.8	18.9	52.2	33.6	48.8	208.6
Comm streets											
Unpaved roads											
Cleared areas	5.2 ac	0.1									0.1
Construction											
Agriculture											
Storage areas	6 ac		0.1					0.1			0.2
Unpaved pkg lots	3.7 ac		0.1				0.4	0.3		0.4	1.2

Recap	Emissions by sector, t/yr			
	1	2-5	6-9	Total
COMBUSTION	14.0	33.8	140.7	188.5
IND PROCESSES	2.0	55.0	75.0	132.0
FUGITIVE DUST	23.7	31.7	155.7	211.1
Total	39.7	120.5	371.4	531.6

DESCRIPTION OF SITE

SAROAD code - 39 7140 026

Location - Broad and Spruce Streets

Monitor height - 15 ft, on AMS trailer

Land use, by sector -

1a central commercial	6 central commercial
1b central commercial	7 dense residential
1c central commercial	8 dense residential
1d central commercial	9 central commercial
2 central commercial	10 dense residential
3 dense residential	11 dense residential
4 dense residential	12 heavy industry
5 central commercial	13 dense residential

Topography - no special terrain

Localized sources, within 200 ft of monitor -

Source	Distance	Description
Spruce Street	25 ft	8000 ADT, clean, curbed
South Broad Street	25 ft	24,300 ADT, clean, curbed

Air quality data -

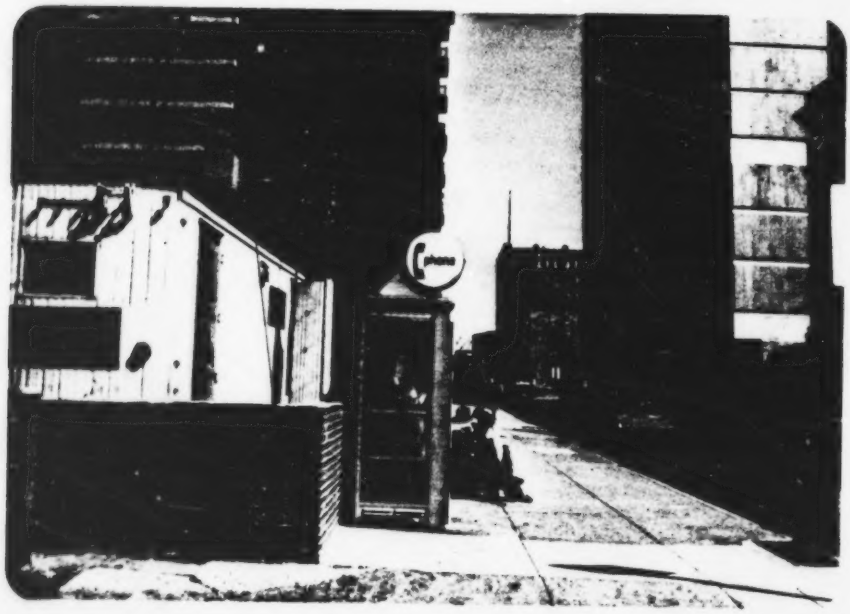
Year	Annual geometric mean, ug/m^3	No. of samples
1976	117	This information was not available
1975	114	
1974	116	
1973	-	

One mile radius around Broad and Spruce Streets site.

Scale 1" = 400'

One-quarter mile radius around Broad and Spruce Streets site.

Viewed to the west-northwest.



Viewed to the east-southeast.
Sampler at Broad and Spruce Streets.

POINT SOURCE SUMMARY

Site: Broad and Spruce Streets

Plant number	Emission level, t/yr	Distance from site, mi	Compass direction,°
31	28	1.1	36
30	103	1.3	254
10	87	1.7	138
33	240	1.7	61
39	25	2.0	141
22	26	2.0	42
18	57	2.1	75
1	477	2.2	235
32	29	2.2	219
17	72	2.2	55
40	50	2.5	129
15	58	2.9	61
14	120	3.1	156
27	31	3.1	49
23	880	3.3	204
3	506	3.7	221
29	63	3.7	162
4	343	4.0	193
16	300	4.2	56
12	29	4.3	358
24	52	4.4	45
5	57	4.5	346
38	37	4.6	46
20	69	4.9	60

AREA SOURCE SUMMARY

Site: Broad and Spruce Streets

Source category	Activity rate	Emissions by sector, ton/yr									
		1	2	3	4	5	6	7	8	9	Total
COMBUSTION:											
Residential fuel		5.3	4.0	4.0	4.0	4.0	15.8	15.8	15.8	15.8	84.5
Comm/Ind fuel		1.3	1.0	1.0	1.0	1.0	3.8	3.8	3.8	3.8	20.5
Incinerators											
Rail/Air/Vessels		0.4	0.3	0.3	0.3	0.3	1.3	1.3	1.3	1.3	6.8
Auto exhaust	155×10^6 VMT	8.8	6.2	1.4	4.6	6.6	31.8	6.5	8.1	28.4	102.4
INDUS PROCESSES:											
Ind processes				6.0			2.0	6.0	8.0		22.0
FUGITIVE DUST:											
Railroad yards	3 ac						0.1				0.1
Clean streets	155×10^6 VMT	44.3	31.1	7.3	23.2	33.2	159.1	32.4	40.5	142.2	513.3
Comm streets											
Unpaved roads											
Cleared areas	4.4 ac			0.6	0.8						1.4
Construction	1.7 ac							0.8			0.8
Agriculture											
Storage areas											
Unpaved pkg lots	3.5 ac						1.2	2.3	0.1	0.1	3.7

Recap	Emissions by sector, t/yr			
	1	2-5	6-9	Total
COMBUSTION	15.8	40.0	158.4	214.2
IND PROCESSES		6.0	16.0	22.0
FUGITIVE DUST	44.3	96.2	378.8	519.3
Total	60.1	142.2	553.2	755.5

DESCRIPTION OF SITE

SAROAD code - 39 7140 023

Location - Sewage Plant, Front and
Pacha Streets

Monitor height - 3 ft, on concrete slab

Land use, by sector -

1a light industry
1b light industry
1c light industry
1d light industry

2 light industry
3 general industry
4 light industry
5 light industry

6 heavy industry
7 general industry
8 light industry
9 dense residential

10 dense residential
11 dense residential
12 heavy industry
13 dense residential

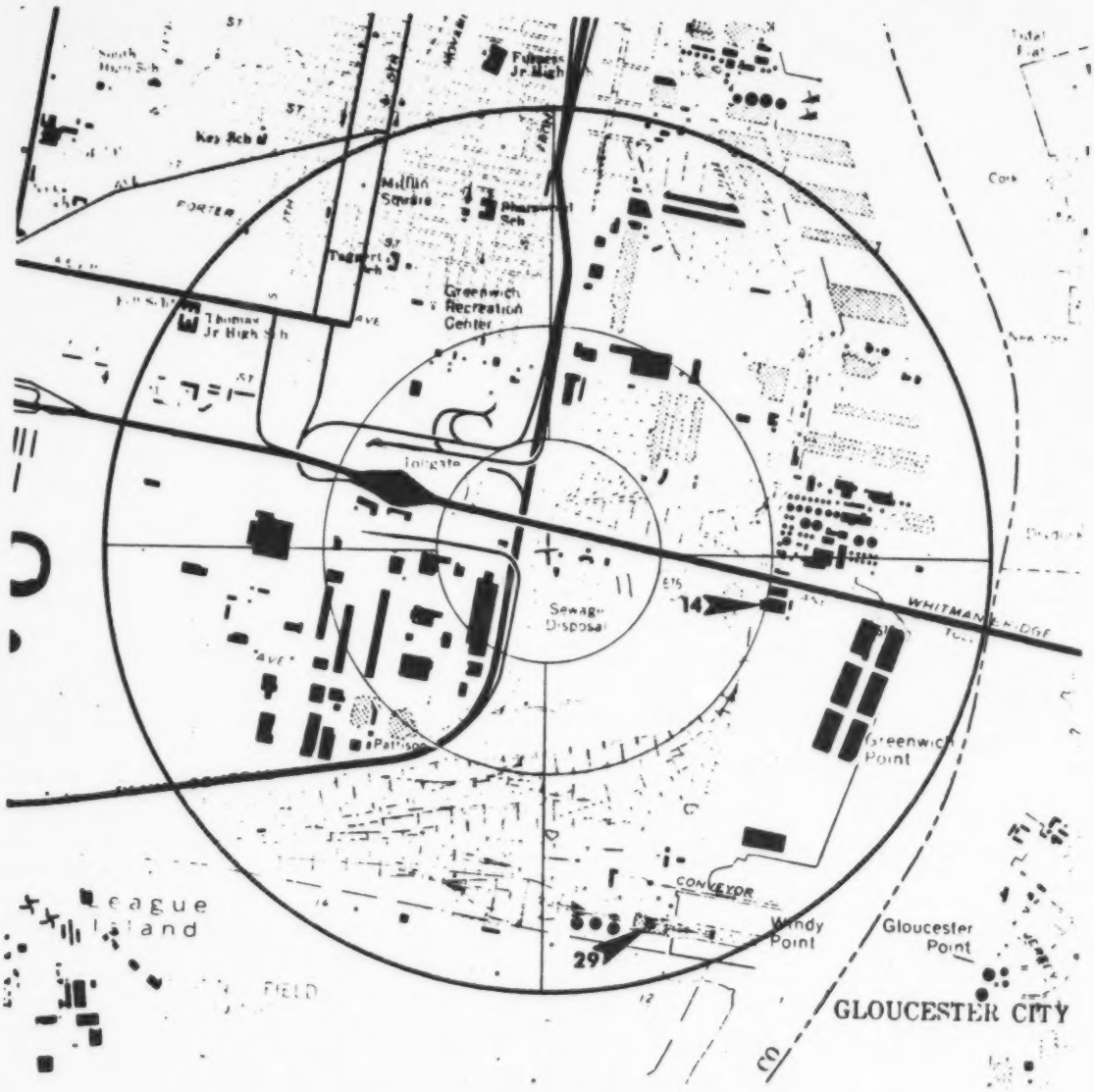
Topography - no special terrain

Localized sources, within 200 ft of monitor -

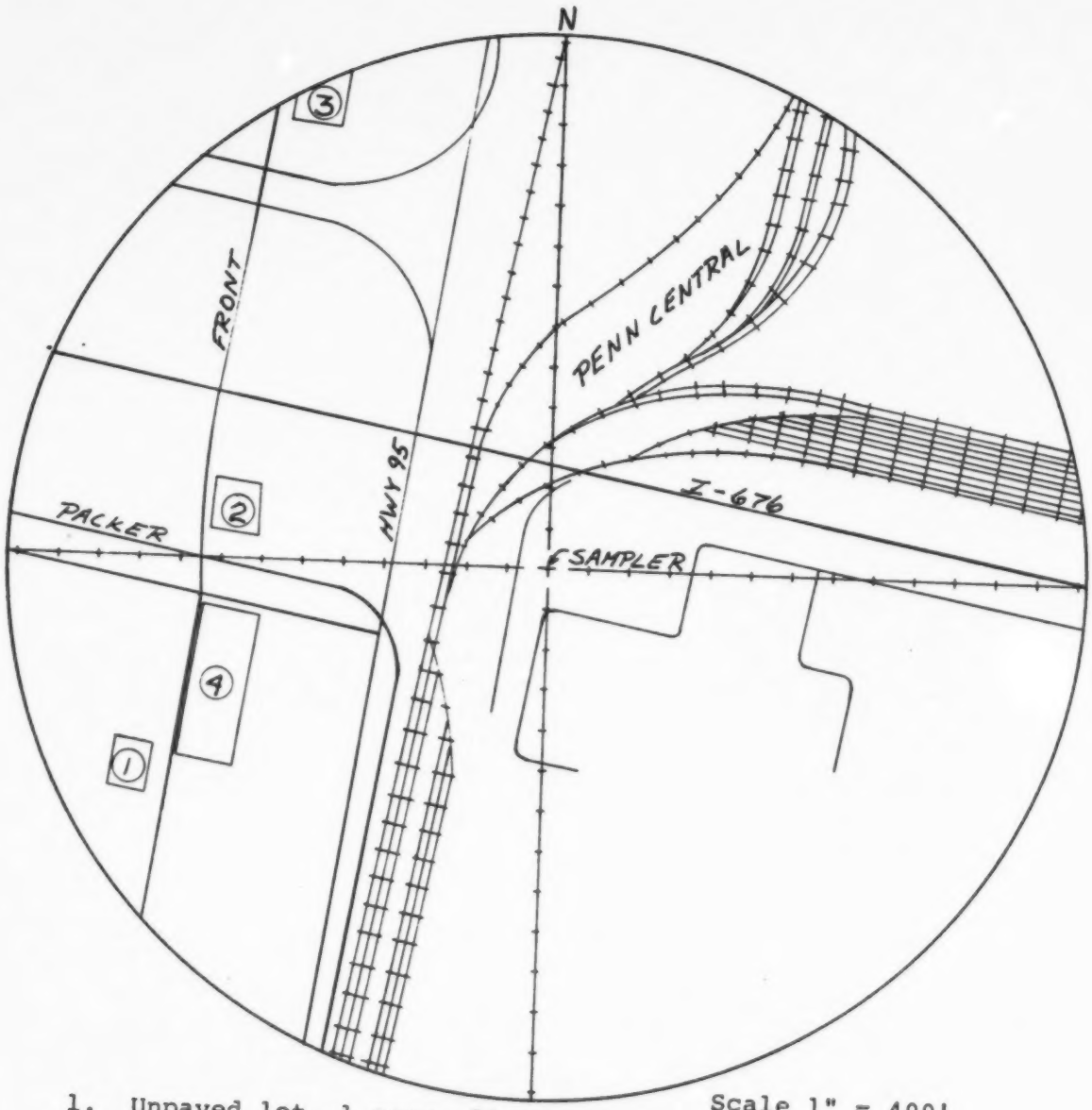
Source	Distance	Description
Unpaved road	60 ft	200 ft long, no traffic

Air quality data -

Year	Annual geometric mean, ug/m^3	No. of samples
1976	90	This information was not available
1975	90	
1974	78	
1973	77	



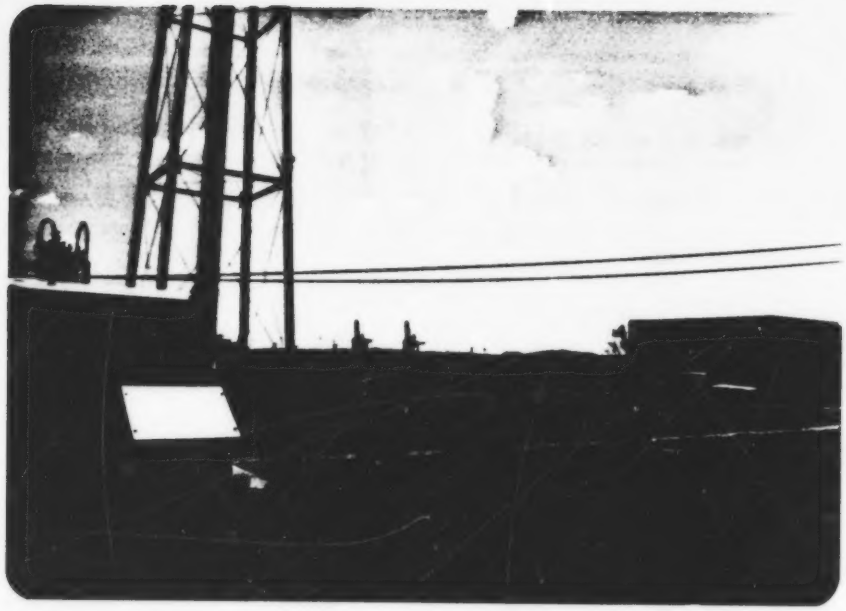
One mile radius around Sewage Plant, Front and Pacha Streets site.



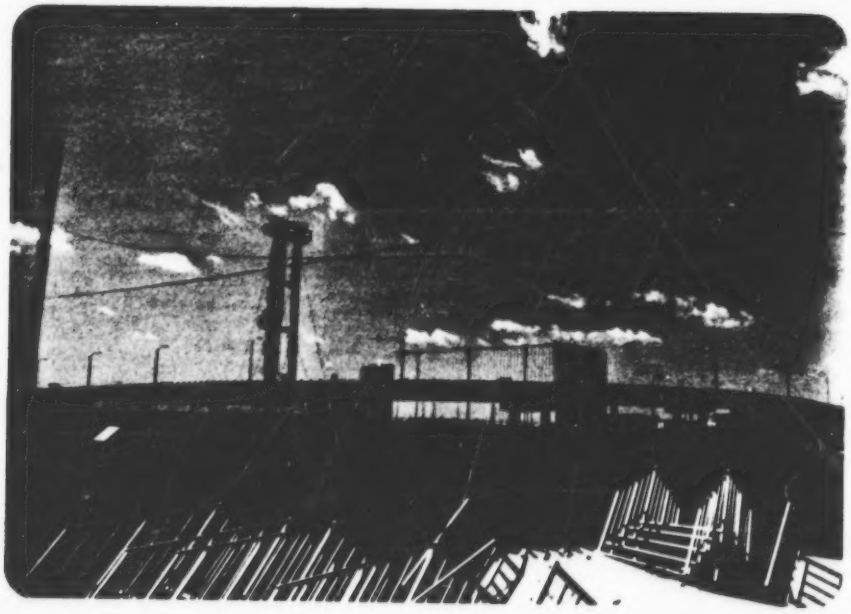
Scale 1" = 400'

1. Unpaved lot, 1 acre, 50 cars
2. Unpaved lot, 1 acre, 50 cars
3. Unpaved lot, 3.7 acres, 200 trucks
4. Unpaved lot, 0.1 acre, 10 cars

One-quarter mile radius around Sewage Plant, Front and Pacha Streets site.



Viewed to the east-southeast.



Viewed to the southwest.
Sampler at Sewage Plant, Front and Pacha Street.

POINT SOURCE SUMMARY

Site: Sewage Plant, Front and Pacha Streets

Plant number	Emission level, t/yr	Distance from site, mi	Compass direction, °
14	120	.51	99
29	63	.76	165
39	25	1.3	19
10	87	1.5	12
40	50	1.6	44
4	343	2.1	133
23	880	2.4	265
32	29	2.4	294
41	127	2.5	182
1	477	3.1	296
30	103	3.2	315
3	506	3.4	269
31	28	3.5	355
18	57	3.6	305
33	240	3.7	13
17	72	4.0	14
22	26	4.2	18
27	31	5.0	16

AREA SOURCE SUMMARY

Site: Sewage Plant, Front and Pacha Streets

Source category	Activity rate	Emissions by sector, ton/yr									
		1	2	3	4	5	6	7	8	9	Total
COMBUSTION:											
Residential fuel						4.0				15.9	19.9
Comm/Ind fuel		1.1	0.8	0.8	0.8		3.2	3.2	3.2		13.1
Incinerators											
Rail/Air/Vessels		3.2	2.4	2.4	2.4		9.6	9.6	9.6		39.2
Auto exhaust	75.9×10^6 VMT	9.6	2.0	4.1	0.4	6.7	4.5	9.3	1.3	14.1	52.0
INDUS PROCESSES:											
Ind processes			13.0		3.0		10.0		4.0	2.0	32.0
FUGITIVE DUST:											
Railroad yards	259 ac	0.8	1.2	0.2	0.1		1.2	2.0	4.8		10.3
Clean streets	75.9×10^6 VMT	47.9	9.9	20.5	2.2	33.9	22.4	46.4	6.8	70.7	260.7
Comm streets											
Unpaved roads											
Cleared areas	3 ac			0.1							0.1
Construction											
Agriculture											
Storage areas	27.6 ac				1.8		0.6	4.2			6.6
Unpaved pkg lots	10.7 ac	3.9	0.4		0.2		1.1				5.6

Recap	Emissions by sector, t/yr			
	1	2-5	6-9	Total
COMBUSTION	13.9	26.8	83.5	124.2
IND PROCESSES		16.0	16.0	32.0
FUGITIVE DUST	52.6	70.5	160.2	283.3
Total	66.5	113.3	259.7	439.5

DESCRIPTION OF SITE

SAROAD code - 39 7140 003

Location - 500 South Broad Street

Monitor height - 35 ft, on gravel roof

Land use, by sector -

1a central commercial	6 central commercial
1b central commercial	7 dense residential
1c central commercial	8 dense residential
1d central commercial	9 central commercial
2 suburban commercial	10 dense residential
3 dense residential	11 dense residential
4 dense residential	12 heavy industry
5 suburban commercial	13 dense residential

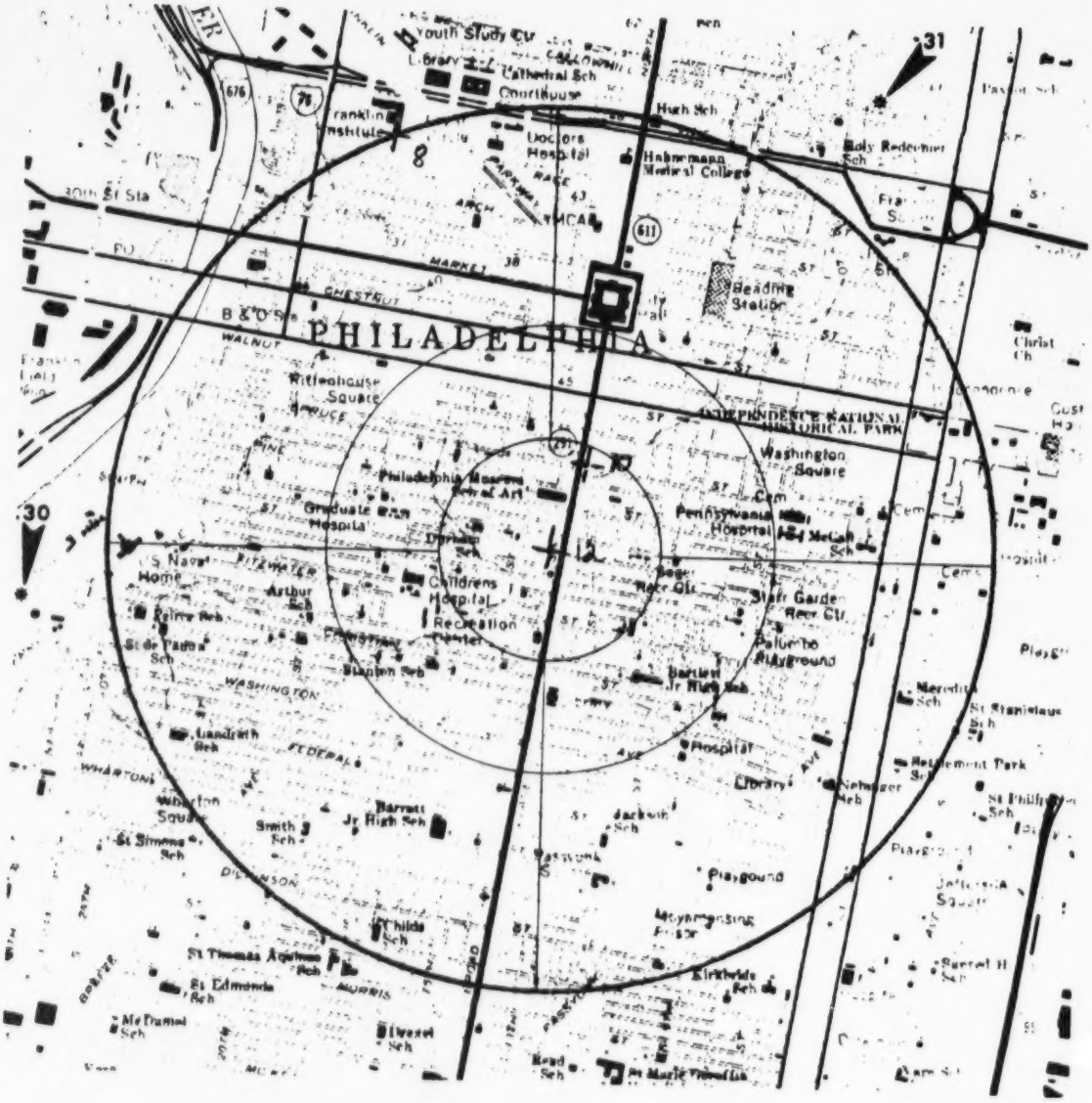
Topography - no special terrain

Localized sources, within 200 ft of monitor -

Source	Distance	Description
Lombard Street	180 ft	8400 ADT, clean, curbed
South Broad	120 ft	23,900 ADT, clean, curbed
Bodman Street	100 ft	100 ADT, clean, curbed

Air quality data -

Year	Annual geometric mean, ug/m^3	No. of samples
1976	74	This information was not available
1975	71	
1974	75	
1973	75	



One mile radius around 500 South Broad Street site.

Scale 1" = 400'

1. Exposed area, 1.4 acres

One-quarter mile radius around 500 South Broad Street site.

Viewed to the south-southeast.

Viewed to the west-northwest.
Sampler at 500 South Broad Street.

POINT SOURCE SUMMARY

Site: 500 South Broad Street

Plant number	Emission level, t/yr	Distance from site, mi	Compass direction, °
30	103	1.2	265
31	28	1.3	35
10	87	1.6	132
39	25	1.9	135
32	29	1.9	219
18	57	1.9	260
33	240	1.9	56
1	477	2.0	240
22	26	2.2	42
17	72	2.3	54
40	50	2.4	128
15	58	2.7	124
14	120	2.9	152
23	880	3.1	208
17	72	3.3	53
27	31	3.3	44
29	63	3.4	162
3	506	3.5	222
4	343	3.8	190
16	300	4.4	55
12	29	4.5	358
24	52	4.6	46
5	57	4.6	346
38	37	4.9	47
20	69	5.0	59

AREA SOURCE SUMMARY

Site: 500 South Broad Street

Source category	Activity rate	Emissions by sector, ton/yr									
		1	2	3	4	5	6	7	8	9	Total
COMBUSTION:											
Residential fuel		5.2	3.9	3.9	3.9	3.9	15.5	15.5	15.5	15.5	82.8
Comm/Ind fuel		1.3	1.0	1.0	1.0	1.0	3.8	3.8	3.8	3.8	20.5
Incinerators											
Rail/Air/Vessels		1.6	1.2	1.2	1.2	1.2	4.7	4.7	4.7	4.7	25.2
Auto exhaust	133.6×10^6	6.8	7.6	2.9	3.6	5.0	29.1	5.8	2.2	25.2	88.2
INDUS PROCESSES:											
Ind processes				3.0			1.0	3.0			7.0
FUGITIVE DUST:											
Railroad yards							0.1				0.1
Clean streets	133.6×10^6	34.3	38.2	14.6	18.1	24.9	145.5	29.0	11.0	126.3	441.9
Comm streets											
Unpaved roads											
Cleared areas	5.5 ac										
Construction	2.7 ac			0.6		0.8		0.1			0.1
Agriculture								0.8			2.2
Storage areas											
Unpaved pkg lots	2.0 ac			2.3	0.1						2.4

Recap	Emissions by sector, t/yr			
	1	2-5	6-9	Total
COMBUSTION	14.9	43.5	158.3	216.7
IND PROCESSES	-	3.0	4.0	7.0
FUGITIVE DUST	34.3	99.6	312.8	446.7
Total	49.2	146.1	475.1	670.4

APPENDIX A

LISTING OF POINT SOURCES IN THE PHILADELPHIA AQCR

Table A-1. LISTING OF POINT SOURCES IN THE PHILADELPHIA AQCR

No.	Name	State	County	AQCR	ID#	Emission, tpy	Stack ht,ft	UTM Coord x	UTM Coord y	SIC
1.	Atlantic Richfield Company	39	7160	045	1501	43	46	482.7	4418.2	2911
						62	135			
						64	130			
						139	110			
						13	160			
						123	80			
						33	173			
2.	Frankford Arsenal	39	7160	045	9704	36	50	494.5	4428.6	9119
3.	Gulf Oil Company of Pennsylvania	39	7160	045	1511	20	150	481.7	4417.4	2911
						443	200			
						43	90			
4.	U.S. Naval Base	39	7160	045	9702	25	100	484.5	4415.3	9137
						48	0			
						270	90			
5.	EPPI	39	7160	045	9606	57	200	484.4	4428.7	8061
6.	Rohm and Haas Company	39	7160	045	1531	16	38	494.7	4428.2	2879
						48	30			
						11	50			
7.	Philadelphia State Hospital	39	7160	045	9602	99	175	500.2	4440.0	8061
8.	Allied Chemical Corporation	39	7160	045	1551	124	137	483.9	4428.2	2879
						108	133			
9.	Holmesburg Prison	39	7160	045	9518	52	120	498.2	4431.6	9309
10.	Amstar Corporation	39	7160	045	1562	19	112	487.7	4419.7	2062
						55	320			
						13	157			
11.	Budd Company	39	7160	045	1563	13	35	496.4	4439.8	3742
12.	The Budd Company	39	7160	045	1564	11	150	485.6	4428.6	3714
						16	100			
						2	40			

Table A-1 (continued). LISTING OF POINT SOURCES IN THE PHILADELPHIA AQCR

No.	Name	State	County	AQCR	ID#	Emission, tpy	Stack ht,ft	UTM Coord x	y	SIC
13.	Container Corporation of America	39	7160	045	1566	66	175	479.4	4431.5	2631
14.	Publicker Industries	39	7160	045	1577	28	149	488.1	4417.2	2818
						92	164			
15.	U.S. Gypsum	39	7160	045	1581	38	52	481.7	4419.7	3275
						10	45			
						10	70			
16.	Bunge Corporation	39	7160	045	1587	300	0	491.6	4425.5	2041
17.	National Sugar Company	39	7160	045	1588	10	100	488.7	4423.6	2061
						20	153			
						42	201			
18.	Celotex Corporation	39	7160	045	1589	11	25	482.7	4420.9	2952
						24	0			
						22	100			
19.	Atlantic Metals	39	7160	045	2007	25	60	492.7	4426.5	3341
20.	Franklin Smelting	39	7160	045	2015	44	0	492.6	4425.8	3339
						25	72			
21.	GFI Crown Products	39	7160	045	2037	28	30	492.2	4427.7	2279
22.	C. Schmidt & Sons	39	7160	045	2044	26	170	488.1	4424.0	2082
23.	Tidewater Grain	39	7160	045	2064	80	150	483.4	4417.1	5053
						800	0			
24.	Imperial Metal Company	39	7160	045	3145	52	100	491.3	4426.5	3356
25.	Moore Push Pin	39	7160	045	3194	35	85	486.2	4430.1	3461
26.	Newman and Company	39	7160	045	3489	36	50			2631
27.	Cattle Galv.	39	7160	045	3613	31	60	489.5	4425.1	1477
28.	Cardo	39	7160	045	3647	48	26	489.5	4429.1	7539
29.	Conrail	39	7160	045	4003	63	0	487.9	4415.9	4463
30.	Philadelphia Electric Company	39	7160	045	4904	50	227	483.9	4421.2	4911
						28	275			
						25	255			

Table A-1 (continued). LISTING OF POINT SOURCES IN THE PHILADELPHIA AQCR

No.	Name	State	County	AQCR	ID#	Emission, tpy	Stack ht,ft	UTM Coord x	UTM Coord y	SIC
31.	Philadelphia Electric Company	39	7160	045	4906	28	183	486.9	4423.0	4911
32.	PGW Station	39	7160	045	4921	2	45	483.7	4418.9	4911
						16	175			
						11	60			
33.	E.C. Incinerator	39	7160	045	9504	240	123	488.4	4423.1	9349
34.	N.W. Incinerator	39	7160	045	9505	160	140	479.4	4432.1	9349
35.	Harrowgate Incinerator	39	7160	045	9508	412	170	490.4	4429.2	9349
36.	N.E. Incinerator	39	7160	045	9509	306	165	493.3	4425.6	4953
37.	Philadelphia Coke Division	39	7160	045	1576	302	0	494.0	4427.0	3311
38.	J. Stern, Incorporated	39	7160	045	2008	12	300			
						14	40	491.5	4426.7	2843
						17	31			
39.	Kerr McGee Chemical	39	7160	045	2028	6	35			
40.	Campbell Soup	39	7160	045	0038	25	100	488.0	4419.2	2871
						16	238	488.8	4421.9	2032
						18	236			
41.	Texaco	39	7160	045	0004	16	107			
42.	Matteo	39	7160	045	0026	127	221	487.0	4413.0	2911
43.	Philadelphia Electric Company	39	7160	045	0010	155	25	483.0	4409.7	4953
44.	Delaware Company Disposal	39	7160	045	0037	1447	248	471.0	4409.7	4911
45.	Allentown Portland Cement	39	7160	045	0029	254	250	471.0	4422.8	4953
46.	Alan Wood Steel Company	39	7160	045	0050	250	150	472.2	4436.5	3241
						612	200	472.2	4437.8	3312
						135	48			
47.	Philadelphia Gas Works	39	7160	045	4922	151	100			
						26		492.3	4425.8	4925

APPENDIX B

DEVELOPMENT OF EMISSION FACTORS

RAILROAD YARDS

Most of the emissions in train yards appear to be from wind erosion rather than from train movement. Therefore, an adaptation of the U.S. Department of Agriculture's wind erosion equation was used as the basis for deriving emission factors for railroad yards. The modified equation estimates annual suspended particulate emissions due to wind erosion from exposed soil surfaces:[12]

$$E = a\ I\ K\ C\ L'\ V' \qquad \text{(eq.1)}$$

where E = emission factor, ton/acre/yr

a = portion of total wind erosion losses that would be measured as suspended particulate, estimated to be 0.025

I = soil erodibility, ton/acre/yr

K = surface roughness factor

C = climatic factor

L' = unsheltered field width factor

V' = vegetative cover factor

In this equation, K, C, L', and V' are all dimensionless. An average erodiblity (I) of 86 ton/acre/yr was assumed to be applicable for the soil in the railroad yards. The area around railroad yards generally has a fairly smooth surface which is equivalent to a K value of 1.0. The climatic factor for the Philadelphia area is 0.03. An average width of 1000 ft was assumed for railroad yards, since this is not a critical variable in the equation. The L' value equivalent to L = 1000 ft was determined from a nomograph in which soil type is also a variable--0.85. There is no vegetation in rail yards so V = 0 and V' = 1.0. Also, these areas are generally treated with oil or chemicals to reduce

dust and weed problems. Therefore, the emissions have been estimated with the above values and the following assumptions:

- no vegetation
- sandy soil (I = 86)
- half the area is stabilized, with an emission rate of 20 percent of the unstabilized area
- train traffic increases the wind erosion emissions by 20 percent

Therefore, the resulting emission factor is:

$$E = (0.025)(86)(1.0)(0.03)(0.85)(1.0)\left(\frac{1 + 0.2}{2}\right)(1.2)$$

$$= 0.04 \text{ ton/acre/yr}$$

REENTRAINED DUST FROM PAVED STREETS

The most recent emission factors for estimating emissions from paved roads were obtained from a draft of AP-42. The recommended emission factors are 5.0 gm/VMT for clean streets and 20 gm/VMT for commercial streets. These factors include an exhaust emission factor and are not corrected for days with rain.

Based on national estimates for the percentage of heavy duty gasoline and diesel trucks, an exhaust emission factor of 0.6 gm/VMT was calculated from published emission factor data.[13] This factor was subtracted from the paved road emission factors and the resulting values were corrected for rainfall.

Historical rainfall data for Philadelphia indicate a mean of 116 days with at least 0.01 inch of rain.[14] Based on this information, the reentrained dust emission factors

were reduced by approximately 35 percent. The corrected emission factors are: 3.0 gm/VMT for clean streets and 13.2 gm/VMT for commercial streets.

UNPAVED ROADS

Many different groups have investigated emissions from unpaved roads. All the studies show emission rates usually in the range of one to 20 lb/VMT, and show that the rate is highly dependent on vehicle speed. After reviewing these studies, EPA selected the following emission factor for publication in AP-42:[13]

$$E = (0.6)(0.81)(s)(S/30)\left(\frac{365 - w}{365}\right) \quad \text{(eq.2)}$$

where E = emission factor, lb/VMT

0.6 = fraction of total particulate less than 30 u diameter

s = percent silt of road surface material

S = average vehicle speed, mph

w = mean annual number of days with 0.01 inch or more of rainfall

The percent silt on gravel road surfaces is about 12 percent based on data presented in the EPA publication, Development of Emission Factors for Fugitive Dust Sources.[12] For graded and drained road surfaces, no aggregate material is applied to the roadbed so it is composed of compacted native soil. The fine material originally on the surface is probably rapidly removed by turbulence from passing vehicles or by wind and water erosion forces. The remaining stable surface is composed of sand- and pebble-sized particles, with dust being generated primarily by the continuing mechanical breakdown of these particles as a result of traffic.

It is assumed that the percent of silt-sized particles on a seasoned dirt road surface is approximately the same as that for gravel, or 12 percent. The mean number of days with 0.01 inch or more of rainfall is 116. Assuming a vehicle speed of 20 mph, the average emission factor is 2.6 lb/VMT.

CLEARED OR EXPOSED AREAS

The modified wind erosion equation described earlier was used for estimating emissions from cleared or exposed areas. An average erodibility (I) of 47 ton/acre/yr was assumed for the soil types common to this area. The cleared areas are generally left with a fairly smooth surface, which is equivalent to a K value of 1.0. The climatic factor for the Philadelphia area is 0.03. An average field width of 1000 ft was assumed for all the cleared areas, since this is not a critical variable in the equation. The L' value equivalent to L = 1000 ft was determined from a nomograph in which soil type is also a variable--0.68. There is no vegetation on cleared areas, so V = 0 and V' = 1.0.

Based on these input data, the average emission rate from cleared areas would be 0.02 ton/acre/yr.

CONSTRUCTION

The emission factor presented in AP-42 of 1.2 ton/acre/mo was corrected for the climatic conditions in Philadelphia by use of the equation:[14]

$$E = \frac{1.2}{(PE/50)^2} \qquad \text{(eq.3)}$$

where PE = 120 for Philadelphia

E = 0.21 ton/acre/mo

This value is appropriate for residential and commercial construction with excavation and regrading, and includes the effect on emission reduction of moderate watering of the site. Most construction projects are assumed to be fugitive dust sources for only three or four months a year.

AGGREGATE STORAGE AREAS

The emission factor for this source category was based on sampling performed in the Kansas City and Cincinnati areas. The emission factor (E) is:[13]

$$E = \frac{13.2}{(PE/150)^2} \qquad \text{(eq.5)}$$

where PE = 120 for Philadelphia
E = emission factor, lb/acre/day

Assuming activity for six days a week, the annual emission factor is:

$$E = 1.4 \text{ ton/acre/yr}$$

UNPAVED PARKING LOTS

If the average number of vehicles using a parking lot daily and the average distance of travel in the lot can be estimated, these data can be converted to VMT/yr and then multiplied by the emission factor for unpaved roads to determine unpaved parking lot emissions. With an average speed of 10 mph in the parking lots, the emission factor is 1.3 lb/VMT. Usage of most lots for five or six days per week was assumed in calculating annual VMT.

UNPAVED STORAGE AREAS

No factor was found for this source category. By comparison with other source categories, it was estimated that annual emissions per acre from this source were greater than for a cleared area (0.02 ton/acre/yr) or railroad yards (0.04), but not nearly as high as aggregate storage (1.4) or construction (.84). A value of 0.1 ton/acre/yr was used for this minor source category.

GRAIN ELEVATORS

A value of 1.80 ton/silo/yr was developed from file data for a previous PEDCo study of particulate air quality in rural Kansas and Nebraska.[1] This same value was applied here for sources for which NEDS data were not available.

INCINERATORS

The emission factor for multiple chamber industrial/commercial incinerators from AP-42 was used in this inventory.[13] That value is 7.0 lb/ton of refuse incinerated.

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